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No. 16

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WEST EUROPE REPORT

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CONTENTS PAGE

DENMARK

State of ADP Industry, Skills Examined (BERLINGSKE TIDENDE, 10, 15 Jan 80).................... 1

Problems With NATO Contract
Improvement of ADP Capability, by Erik Bendt Rasmussen

FEDERAL REPUBLIC OF GERMANY

Government, Industry Study Future of Software Market (Joachim Kanngiesser; ONLINE, No 12, 1979)............ 4

Prospects for Oil Shale Exploitation (Karl-Heinz Preuse; FRANKFURTER RUNDSCHAU, 21 Jan 80).. 11

FINLAND

Use of Peat for Power Generation in Finland (Erik Liden; SVENSKA DAGBLADET, 9 Jan 80)............. 13

FRANCE

Prospects for Alternate Energy Sources in Ile-de-France Explored (AFP SCIENCES, 20 Dec 79)............................ 16

National Ocean Policy Instituted (AFP SCIENCES, 10 Jan 80)................................ 18

Clear Policy Needed
Program for Reform

CONTENTS (Continued) Page

Policy for Development of Ocean Resources
(SEMAINE DE L'ENERGIE, 10 Jan 80).................... 21

Studies on Using Ocean Energy for Thermal Power Plants
(AFP SCIENCES, 17 Jan 80)............................ 22

ITALY

Minister Criticizes Government Organization of R&D Support
(AVIAZIONE, Dec 79-Jan 80)........................... 23

Research Minister Outlines Future of Space Program
(Fabio Pagan; AVIAZIONE, Dec 79-Jan 80).............. 25

Prospects for Alternative Sources of Electrical Energy
(L. Paris, G. Castelli; FONTI DI ENERGIA ALTERNATIVE, Jul-Aug 79).. 28

SWEDEN

Use of Peat for Power Generation in Sweden
(Erik Liden; SVENSKA DAGBLADET, 9 Jan 80)............ 55

20-Year Prospects
First Major Power Plant

'Earth Heating' System Saves Domestic Energy
(Margareta Artsman; SVENSKA DAGBLADET, 7 Jan 80)..... 58

Inertial Energy Storage Device for Vehicles
(Roland Gyllander; DAGENS NYHETER, 29 Dec 79)........ 62

DENMARK

STATE OF ADP INDUSTRY, SKILLS EXAMINED

Problems With NATO Contract

Copenhagen BERLINGSKE TIDENDE in Danish 10 Jan 80 p 8

[Article: "NATO Orders Cause Disclosures"]

[Text] A Danish ADP firm's huge order from NATO has contributed to a demonstration of weaknesses but also positive qualities in the Danish educational aystem.

To look on the positive side first, Civil Engineer Christian Rovsing, whose firm received the big NATO order, is full of praise for the education of computer engineer at Denmark's Tekniske Hjskole [Denmark's Technical University]. Since one aspect of the university's operations has recently been severely criticized, it is important to attain information concerning the satisfaction of the recipients as far as another of the university's products are concerned.

Recent criticism of Denmark's Tekniske Højskole was directed against administrative procedures. The negative aspect of the Danish educational system which again is brought to light by the NATO order also touches on administrative matters, in this case particularly as concerns the University of Copenhagen. There the students of computer science cannot complete their education because there is a serious lack of teachers for the part time students. Of about 70 candidates, only 10-15 complete their degrees each year. The damands for students is so great that many get jobs in industry before their education is completed, and they become a kind of half-baked professional.

When the University of Copenhagen, which at this point speaks in large capitals about the danger of universities losing their autonomy, is not capable of meeting the demand for teachers in computer studies, this is partly a result of many years of hostility toward industry. For many year the universities have, with striking lack of logic and consistency, agitated in favor of the social relevance of higher education. A very clear word has become so politically charged that it has completely lost its meaning. In university parlance social relevance has become almost synonymous with hostility toward industry. The university president now in office even considers it socially relevant to give M.A. degrees to humanists, educating them to unemployment, because it is better for someone to be highly educated and unemployed than to have a "lowly" education. He has expressed this concept while confronted with the inherited task of acquiring teachers for the M.A. program in computer science, a program that would produce graduates that the market place is simply waiting to employ. If he is now moving toward a different point of view, this is encouraging.

Christer Rovsing has used the opportunity to voice a warm defense of the right to freedom of research on the part of the institutions of higher learning. By and by universities and other educational institutions will come to realize that freedom of research cannot be saved from harmful interference unless a changed practical interpretation of the concept of social relevance is introduced into teaching and curriculum. Institutions of higher learning cannot continue to disregard the demands of industry of which, over the long stretch, freedom of research is one. This now occurs in violation of the original intentions of administrative rules, intentions which included a modicum of contact between the parties.

Improvement of ADP Capability

Copenhagen BERLINGSKE TIDENDE in Danish 15 Jan p 10

[Article by Erik Bendt Rasmussen: "New ATV Center Will Do Research for ADP Industry"]

[Text] Akademiet for de Tekniske Videnskaper [The Academy of Technical Science] (ATV) has got a new company under its umbrella:

Dansk Datamatik Center [Danish Computer Center] which has been founded as a temporary association of a handful of Danish ADF concerns. The yearly assessment is 100,000 kroner per concern. The aim of the association is a strengthening of the domestic ADP industry. The founders are I/S Datacent centralen which was started in 1959, Regnecentralen, started in 1979, Christian Rovsing, Crone & Koch ADP, Kommunedata, Sparekassernes Datacenter, Teleteknisk Forskninglaboratorium, and Øk Data. At present the new center is searching for a candidate for the presidency who will undertake the construction of Dansk Satamatik Center which has acquired offices at Denmark's Tekniske Højskole.

On a High Level

"The center will develop advanced technical-scientific programs and transmit new information between the institutions of higher learning, private and public enterprises, and support Danish ADP industry, says the acting manager of Dansk Datamatik Center, Vice President Jan Bech from Sparekassernes Datacenter. "We will also be instrumental in furthering cooperation with foreign centers and raise further education to a high professional level."

A Danish ADP center associated with Akademiet for de Tekniske Videnskaber has been lacking and has been demanded by Danish ADP industry for years. The initiative was taken by the founding firms mentioned above which, in view of the assessments they have contributed, have already created an economic base for the center.

Sixth ATV Company

Prof Christian Gram, Dth who is presently on a study trip in the U.S., is the manager of Dansk Datamatik Center, which is the sixth company associated with the academy. A recent fifth addition, Danmedia, with manager Mogens Boman at its head, will do research into ADP-based long distance and mass communications.

In addition to the companies, ATV encompasses 19 institutions, for example Svejsecentralen and Elektronikcentralen. The difference between companies and institutions is that the first are financed by contributions from the members and, unlike the institutions, they do not have their own laboratories for research and experiments. The institutions are to a large degree self-supporting through their work for Danish industry.

9542
CSO: 3102

GOVERNMENT, INDUSTRY STUDY FUTURE OF SOFTWARE MARKET

Cologne ONLINE in German No 12, 1979 pp 1006, 1008-1010

[Article by Joachim Kanngiesser: "Applications Software--EDP, Problem Child of the 1980's?"]

> [Text] Of the 1,138 commercial applications software products listed in the ISIS Software Report of January, 1979, 262 (23 percent) have been installed more than 10 times and only 50 (4.5 percent) have been installed more than 72 times. An additional fact out of the software sector: On the average, 73 percent of all programing capacity is associated with program maintenance and modifications. With this problem area as a background, the significance of a comprehensive software study which the Society for Mathematics and Data Processing mbH (GMD) has been conducting since the beginning of 1978 in collaboration with Infratest Economic Research will be obvious.

A group of experts from science and EDP practice supported the effort. The research project "Investigation of Measures for Improving Software Production" funded by the minister of research and technology (BMFT) is aimed at researching the supply of software for EDP users and the factors determining this supply, and at revealing possibilities for improvement. GMD presented the most important results of the study to a broad audience of experts (about 100 professional representatives, primarily from hardware manufacturers and software houses).

Significance of the Software Study

The economic significance of the software market today and of its predicted development becomes obvious by considering the volume of the submarket for applications software: In 1978 it amounted to about DM 1.2 billion (high estimate) and for 1982 is estimated at DM 1.9 billion. More than 2,000 firms (excluding hardware companies and computer centers) offer specialized software to the German market.

New EDP, users, especially from small and medium-sized businesses, will enter the software market in growing numbers. Against this background, an analysis of the status of software technology, software products and the software market appears to be urgently needed.

Brief Description of STPMU Study

Since the beginning of 1978, GMD has carried out--under guidance of the society's internal Institute for Software Technology--in collaboration with Infratest Economic Research, a software study "Measures for Improving Software Production." The project, with initials STPMU (Software Technology, Product, Market Investigation), is funded by the BMFT with a budget of DM 2.2 million and 8.5 man years (excluding the software market study). The subtask relating to studying the instantaneous market situation and the development trends in the applications software embraces the larger portion of the study and is being carried out by Infratest.

The primary goal of STPMU consists of analyzing the status of the software supply for EDP users and factors which determine this supply and of showing possibilities for improving the supply situation.

To initiate the STPMU study, the project team posed three largely open questions:

1. Can the quality of software be raised in the intermediate term through an improvement in software technology and can the development cost of software be decreased (if yes, then how)?

2. Can user requirements be covered better through increased use of standard software products?

3. Which competitive relations determine the still young, expanding and dynamically developing software market?

From these three central questions resulted the structure of STPMU. Corresponding to the three research objectives: software technology, software products and software market, the study is divided into three parts.

The Software Technology Study

The software technology study analyzed what theoretical principles are available and what techniques are being tried today and might be tried in the future in the FRG. This study is limited to the analysis of commercial applications software, for example wage and salary deductions and financial and inventory accounting. The focal point of the study lies in the investigation of applications software for use on universal computers; thus the entire life cycle of programs, including maintenance, is considered.

Through cooperation with partner institutions in France (IRIA) and in Great Britain (NCC), GMD was able to look across national borders where basically the same problems are encountered in applying software-technology methods. The practice in software production, especially the methodology of EDP users, is startling even in the 1978/79 period.

--In spite of the cost intensiveness of programing, a considerable portion of the required software is produced by the EDP users themselves. Standard software products are often rejected as being too large and not tailored to the special requirements of the users.

--The largest part of the programing effort (often up to 80 percent) is related to maintenance and modification.

--The shortage of qualified personnel for programing work and a low turnover of personnel lead to individual-dependent programing, which is often equivalent to inadequate program documentation.

--Although at home and abroad, especially in the USA, there exists a widespread appreciation for the importance of using methodical procedures in developing software, still the application of sound methodology--procedures, tools, aids, specifications, etc--is less than expected.

There are no methods which have been applied on a broad front. The use of well-known methods (see INFOTEC study), such as structured coding, structured design, top-down design, chief programmer team, remain limited to program development in dialog, computer based documentation and program management systems, and design and project management areas. In contrast, methods and aids for defining and documenting user requirements (What does the requirements model look like?), for time and cost estimating, testing, accepting, maintaining and modifying software are absent.

The success of a method depends not only on its technical quality but also on management support, implementation strategy and qualifications of the people, especially the readiness to learn. A further reason for the sparse application of methodology lies in the fact that concrete success only occurs through program maintenance. In addition, the application of fragmentary methods does not serve the user; he requires a complete package of methods for the various activities associated with generating software. Such methods packages are, however, available--if at all--only a company specific basis. In spite of the frequently uneconomical in-house generation of applications software, EDP users largely shun the use of standard software.

The Software Product Study

This part of the study is to determine what experiences EDP users have collected in the use of standard software products and to probe if and how a building-block concept leads to versatile software application in a particular case. The basis of the applications study is the ISIS Software Report of January 1979.

A total of 52 EDP vendors (42 software houses and 10 hardware companies) were selected. A total of 31 EDP users (17 large, 14 small) were interviewed. Small users are operations with fewer than 10 members in the EDP section and/or a central computer with performance less than that of an IBM 370/125. The basic questionaire follows the structure of the software-life-cycle model.

With repsect to use experience, future expectations and desired properties of software products, EDP users were presented with a catalog containing 45 selection criteria, for example, software performance, ease of use, cost and vendor, which they were to rate on a scale of 1 to 5.

From the standpoint of user requirements, ease of use, software performance and cost were named as the most important criteria groups. Important individual criteria for selecting user software are:

--Matching software performance with requirements,

--Vendor expertise,

--Compatibility with system software,

--Trial use.

One proposed solution with respect to requirements-directed user software aims at modularization in standard building blocks whose final implementation is effected by the user himself or external service organizations, such as software houses, programing offices or computer centers. By this process, tailoring expenses should be reduced.

In addition to the building-block concept, EDP users desire above all that the software be independent from the physical data structure (84 percent) and that the vendor puts the software on line (74 percent).

EDP users prefer, as a rule, to procure standard software products rather than generate their own when they are confronted with unfamiliar areas of application. The acquisition of software products is mainly by direct purchase (80 percent). In spite of the high investment, a formal selection and decision process is used in only 27 percent of software procurements.

To the extent that EDP users are judged incapable of clearly formulating and transmitting their requirements to vendors in the procurement of applications software, it must also be admitted that the market for software products lacks much in transparency.

The Software Market Study

Comprehensive empirical investigations of basic statistical data provide the basis for this important representative software market study. The objective of this subtask consists of analyzing the market structure, the market behavior and the competitive situation--especially the geographic and economic composition of the software vendors and the supply situation of the users--and to show trends in future market development.

The information of the market study can serve both as an orientation aid for decisions concerning measures for advancing and improving the functional capability of the applications software market and to provide software vendors and EDP users decision data for their respective sales and procurement marketing.

The new theory of competition--in which, for example, market power is retained by efficient vendors, but market entrance by new EDP vendors is also possible--forms the theoretical framework for the study. The structure of the applications software market is strongly influenced by the hardware manufacturers' offerings of hardware and basic software.

In defining the market structure, the composition of EDP user groups (for example, branch, size of operation, user type), the classification of software demand (for example, programing support, standard applications software) and the status of supply to the EDP user (for example, dependence on software vendor) are being investigated. In evaluating demand development, a distinction has been made between the plans of the present EDP users and the plans of future users. Future users will come primarily from small and medium-sized businesses. For this group EDP solutions are a direct and decisive factor for a firm's growth and for retention of its capability to compete.

For these firms, an adequate product and service offering on the EDP market is especially important. The new-user potential (EDP use planned for coming years) amounts, all things considered, to 20,000 companies. Especially interesting target groups for EDP installations are wholesale merchandising firms, automobile repair shops, forwarding companies and doctors.

The demand for applications software for "small budgets" will increase. The emphasis of applications planning is on statistics, planning information, material economics and perhaps cost accounting. Presently, all demand groups sense a deficiency of demand-directed offerings.

The numerous vendors of software services (including hardware manufacturers, software houses, programing offices, independent professional programmers and computer centers) are attempting to fill the market gaps for applications software opened up by the unbundling policy. They supply (usually regionally) EDP users with branch-specific software products.

Such specialized software production is usually not possible for the hardware manufacturers due to their cost structure. These cost advantages are used mainly by small software houses (an especially dynamic vendor development since 1975). Because of their thin capital covering, they can, of course, not always fulfill the demanders' requirements relating to economic stability. Additionally, small software vendors have available neither the required technological potential nor the knowledge of market strategy and the associated distribution channels required to pursue an active market policy in the area of standard applications software.

This market-gap policy of the software vendor will come under pressure in the futute from increased effort by hardware manufacturers (caused by lower hardware prices and the growing importance of software and service offerings). The offering of standard applications software and software technology methods and tools by large hardware manufactuers will lead to a tightening of the market. In this manner hardware manufacturers will attract to themselves the EDP budgets released by sinking hardware prices, and at the same time will move to meet the requirements of the EDP users and offer EDP solutions from a single source.

In evaluating further development trends in the applications software market, flexibility in tailoring the offering to the demand and productivity of software vendors generally stand in the foreground. Characteristic for this market is the absence of homogeneous product and service submarkets (for instance, OEM business by software houses and computer centers.)

In addition to branch specialization (75 percent), the concentration of vendors in regional submarkets is an additional characteristic. Because of their meager technological knowhow and, in some cases, low productivity and economic stability, many small software vendors cannot supply flexible standard applications software solutions. As a result, the unsatisfied demand for standard applications software by large and medium-sized users will increase directly.

Large hardware manufacturers and software houses, especially, can snap up this excess demand. The software branch will not be able to fully exploit the available growth opportunities in the intermediate term. The exist rate of small software vendors from the market will further increase.

The proposals of Infratest for improving the stability of the supply situation and the functioning of competition embrace a supply of information, basic and advanced training of small vendors in the EDP technologies, an offering of preliminary products and development tools for software vendors and the training of user cooperatives (especially for small and medium-sized EDP users).

Discussion of Results

In an open discussion, industry representatives of hardware manufacturers (Nixdorf, CTM), software houses (ADV-ORGA, OCS) and one user cooperative (MIREKON, clothing industry) were invited to take a position on the following topics:

1. Confirmation or criticism of the market prognosis from their viewpoints (for example, supply gaps, growing dominance of large hardware producers),

2. Structural development lines which make possible better exploitation of market potential by software houses (for example, cooperation between software houses or user operation),

3. Technological prerequisites for a broadly effective improvement of the supply situation (for example, vendor's problem consciousness and potential in the area of software technology, starting points and strategies for standardization, improvement of market transparency).

The results of the software market study were generally confirmed. It shows that the offering gap can be traced back to not only to a deficiency of software technological knowhow but also to a deficiency of general knowledge. Users are often incapable of defining their requirements.

The notion of having regional EDP vendors close by was abandoned in favor of industrial study and cooperation groups. In this connection, vertical cooperation between software houses was considered to have some chance; on the other hand horizontal cooperation (for example, of research and development projects) fails because of the differing levels of knowledge. Advantages accrue to software houses having close cooperative ties with hardware manufactuers when they can use the latter's distribution channels.

User cooperation was basically recommended; of course, user cooperatives are impracticable in small and medium-sized operations without external (financial) help. A growing dependence of users in conjunction with the growing dominance of the large hardware manufacturers is decried. On the other hand, dependence of vendor requirements--also in the technological sense--on the strategies of hardware manufacturers was defined. Therefore, software houses should apply their software technological development knowhow more aggressively and develop (hardware independent) user modules which can then be economically produced and distributed.

At this point, the great research need in the area of software technology was pointed out. The passive pursuit of market-gap policy by small and medium-sized software vendors will be made more difficult in the future, especially as a result renewed effort by the large hardware manufactuers. Many software houses must think "Future" if they want to stay in the market for applications software.

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FEDERAL REPUBLIC OF GERMANY

PROSPECTS FOR OIL SHALE EXPLOITATION

Frankfurt/Main FRANKFURTER RUNDSCHAU in German 21 Jan 80 p 11

[Article by Karl-Heinz Preuse: "Oil Shale Exploitation Soon Profitable"]

[Text] The recent sharp increases in oil prices have again aroused interest in an energy source which for the most part still remains untouched within the earth. According to estimates made by the Federal Institute for Geosciences and Raw Materials in Hanover, the FRG has oil shale deposits with an extractable oil content of at least 500 million, and possibly several billion, barrels. Volker Hauff, minister for research, revealed this in response to a Bundestag inquiry.

Only a portion of these deposits is economically exploitable, however, even under the most favorable conditions. About 100 million barrels could probably be extracted from an oil shale deposit in the Schandelah area near Braunschweig, a further approximately 25 million barrels from deposits in Lower Saxony, and about 10 million barrels from deposits in Baden-Wuerttemberg. The conditions for mining are fairly favorable in the Schandelah area, where about 2 billion barrels of oil shale, including the gravel base, are located. The deposits are located in a basin relatively close to the surface and can be extracted entirely by open pit operations.

Braunschweiger Kohlen-Bergwerke in Helmstedt [coal mining corporation] and Veba-Chemie AG [chemical concern] are presently, with the financial aid of the Federal Ministry for Research and Technology (BMFT), engaged in an extensive research project for the extraction and utilization of this shale oil. The feasibility question of future large-scale utilization of oil shale, which is the chief purpose of this investigation, has not yet been definitely answered. This is true of these particular deposits and of other projects for which the FRG government has so far provided about DM 13 million within the framework of a program for energy research and technology. It is certain, however, that rising oil prices make oil shale extraction increasingly attractive.

It is not exactly certain yet which process is to be utilized in the Braunschweig project. The organic components of the shale oil, the so-called kerogens, can be converted into natural gas, oil and coke at temperatures above 450°C. A number of extraction processes have been developed and tested in experimental facilities during the past 30 to 40 years. The Lurgi-Ruhr-gas process has proven to be most promising in experiments with the Braunschweig oil shale. This process was originally developed for the liquification of coal. Concerns for environmental protection play a role in the final process selection, because even though the extraction yield ought to be as favorable as possible, the accompanying environmental stress is to be kept as minimal as possible.

The basic design of the Braunschweig installation is, however, already generally agreed upon, though it has not yet been definitely decided whether it will be built. The mined shale will be sent to the processing facility where it will be ground up and dried. It will then be mixed with circulating hot shale residue and heated to the liquification temperature. In this liquification process, crude shale oil and gas which has a high heating value will be won. The carbon which remains in the shale residue is burnt off and provides the energy for this process. The crude shale oil must then still be prepared for utilization in the conventional refineries. It is, however, already certain that a product can be won through this refining process which will be equivalent to regular crude oil.

Shale oil, or rather the refined product, is however, not the only economically interesting product which can be won from the shale. Geochemical analyses have shown that a considerable number of trace elements are present in attractive concentrations within the Braunschweig oil shale. These include, for example, such raw materials as molybdenum, copper, cobalt, nickle, uranium, thorium, vanadium and rare earths.

9410
CSO: 3102

USE OF PEAT FOR POWER GENERATION IN FINLAND

Stockholm SVENSKA DAGBLADET in Swedish 9 Jan 80 p 7

[Article by Erik Liden: "Finland Invest in Peat Powerplants"]

> [Text] Tammerfors. Today Finland has peat resources that can produce energy for at least 400 years if the country elects to derive 10 percent of its energy from peat. It is estimated that this goal will be reached as early as 1990.

During the 1970's large amounts have been invested in research on the usability of peat for heating and for the production of electricity. Rising oil prices have also resulted in Finland's present investments in large peat powerplants.

The largest peat powerplant in operation is in Tammerfors. AvD [SVENSKA DAGBLADET] visited the installation when it was chewing up 5,000 cubic meters of peat per day. This means a power output of 60 megawatts for electricity and 120 megawatts for heating energy. Already in 1971 the large powerplant acquited an oil furnace with the same output. The peat installation was inaugurated in October of 1977 and experiences during the first 2 years are very positive.

Diminished Need for Oil

Plant Manager Esko Jarva: "It's true that the new plant cost 210 million Finnish marks. However, over a period of 20 years we calculate that our investment will have paid for itself and paid interest as well. The result of present oil prices is that the peat we need to produce a certain amount of energy only costs half as much as a comparable amount of oil. This means that the long run, Finland will be able to reduce its need for Russian oil."

Already today 70 percent of the electric power in Tammerfors comes from the powerplant; the state buys 30 percent. All energy for central heating is produced in the powerplant; 70 percent of it is derived from peat.

"Furthermore peat is kinder to the environment than oil, something that we have already noticed in Tammerfors. After the central heating has been expanded--it now covers more than 50 percent of the households; the city has 175,000 inhabitants--the phosphorus level has gone down since many private oil furnaces have been shut down. At the same time peat produces fewer side effects. The ashes can be used immediately as filling on the lake shores. There are no elements in the ash that are soluble in water."

Today about ten million cubic meters of peat (one million cubic meters of oil) are used to produce energy in Finland. 1.1 million goes to the power plant in Tammerfors. This means that 24 railway cars daily are unloaded at the powerplant. Afterwards the peat is dried and fed into nine different burners after rocks, pieces of wood, metal etc. have been separated out.

In order to achieve a favorable process 5 to 10 percent of oil should be included in the combustion. Depending on the quality of the peat the percentage may need to be raised. In Tammerfors the admixture of oil is presently 19 percent.

When the supply of peat is stopped or when inspections have to be made the powerplant is automatically switched to oil.

When the quality of the peat has been improved with less impurities, better drying, and so on, plant manager Jarva calculates that it will be possible to save at least 25 million Finnish mark per year through cheaper fuel.

One condition is that the transport distance is kept at about 100 Km and that peat is extracted on a large scale.

13 Do Research

At the state technical research center in Helsinki extensive work is carried on by 13 researchers to determine the best way of heating with peat. Research engineer Dan Asplund: "In spite of the fact that for reasons of climate peat can only be extracted between May and August, it has shown itself to be very profitable. Considering the inflated oil prices it should soon be theoretically possible to heat Helsinki with peat in spite of high transportation costs.

We calculate that longer transports than 150 Km do not pay today. But it is probable that this distance will increase during the next few years. At the same time we will try to purify the peat to create effective fuel. We are now determining whether it is economical to do this at the extraction site or if it should be done, as it is now, at the heat and electric plants.

Comparable to 10 percent

"In spite of the limited period of extraction Finland should be able to substitute all energy for peat which in that case would last for 50 years. Practically speaking this will never become a reality; an extraction of 30 million cubic meters in 1990 is the prognosis today. This figure is comparable to barely ten percent of Finland's energy consumption."

Dan Asplund also points out that already today, peat bricks are cheaper than oil for private oil burners in single family dwellings etc. In the long run it will also be possible to produce methanol, which will be cheaper than gasoline, from peat. Already today methanol costs only 10-20 percent more than gasoline when it is produced from peat.

The expansion rate for peat energy in Finland today is 50-100 annually which puts great demands on investments and capital.

In Valkeakoski state-owned Kemira Oy in the Säteri plant with 1500 employees has installed a peat burner which produces 85 megawatts of heating energy. Eighty-five to 90 percent of the plant's energy needs will be met through peat. Already at the present time the plant saves 5 million Finnish marks annually due to less expensive peat.

The investments and rebuilding of an old steam boiler cost 25 million mark of which the state paid six. Eight to ten railway cars deliver 1500 cubic meters of peat daily. This is Finland's largest peat plant for industrial use to date.

More Change Over

More and more cities change to fueling their central heating plants with peat. In Tavastehus with 42,000 inhabitants almost half of the households get their heat from peat. The plant yields 15 megawatts. In three years a large peat powerplant that will produce 80 percent of Tavastehus' heat and electricity needs will be inaugurated. The peat is 70Km from the city which reduces transportation costs.

Director Ahti Alhovaara:

"Our big problem in a couple of years will be the competition with neighboring Valkeakoski about the peat deposits that are close to both cities. It is a determining factor as far as profitability is concerned.

9542
CSO: 3102

PROSPECTS FOR ALTERNATE ENERGY SOURCES IN ILE-DE-FRANCE EXPLORED

Paris AFP SCIENCES in French 20 Dec 79 p 29

[Text] Paris--Geothermal and solar energy are going to be encouraged in Ile-de-France. An effort to develop the use of new energy sources--particularly geothermal and solar energy--will be made in Ile-de-France, according to a statement made by the regional prefect, Lucien Lanier on 13 December, as he presented a report which will be submitted in the near future to the legislature. The report deals with energy economies and new sources of energy.

In regard to the use of geothermal energy, Lanier recalled that Ile-de-France is particularly well located, as it has a layer of hot water of 7,000 square kilometers, doubtless the largest in France. After drilling, it is possible to extract 100 to 200 cubic meters of 70-80 degree water per hour from this layer, which is located at a depth of 1,800 meters. Some 7,500 houses in the region are now being heated by geothermal energy.

In spite of already considerable loans from the state (80 percent of the cost of the first drilling), officials responsible for this kind of work are reluctant to engage in such operations, the prefect emphasized. In his report Lanier also proposes that the region grant a supplementary loan amounting to 20 percent of the investment. The initial financial risk taken by the official responsible for the project would thus be entirely covered.

As for solar energy, the most profitable operations already developed are water heaters, the heating of swimming pools, gymnasiums and school buildings. "Taking into account the density of equipment of this kind in the region, Ile-de-France could become one of the pilot regions," according to the prefect, who proposes that a regional subsidy be granted to the solar energy utilization program.

Lanier also recalled that various projects to reduce oil consumption were being implemented or under study in Ile-de-France, particularly a nuclear power plant in Nogent-sur-Seine (Aube), "For which," he said, "we are awaiting the decision of the public authorities at the end of the public utility investigation."

He also mentioned the installation of "Fossil Fuel" [calogenes] reactors to supply urban heating, whose "economic interest must be reexamined in consideration of increases in the prices of energy." Finally, the prefect brought up the possibility of recovering energy from household garbage: 170,000 equivalent tons of oil [TEP] have already been recovered in Issy-les-Moulineaux, Saint-Ouen and Ivry-sur-Seine, he said.

Four other plants are being built; however, 150,000 equivalent tons of oil are still to be recovered from the household garbage of the province, Lanier emphasized.

In a related development, Alain Griotteray, general reporter of the region's budget, said in Paris on 17 December that the use of geothermal energy was to become one of the priority objectives of Ile-de-France. In this regard, Griotteray said, "Ile-de-France fell several years behind by not following the rest of the province, like the Rhone-Alpes region."

8143
CSO: 3102

NATIONAL OCEAN POLICY INSTITUTED

Clear Policy Needed

Paris AFP SCIENCES in French 10 Jan 80 p 7

[Text] Paris. Government wishes to affirm ocean policy. Mr. Andre Giraud, minister of industry, declared on 9 January that he would take under consideration "France's considerable marine dimension."

During the preparation of the Eighth Plan, the industry minister indicated that he insisted on making sure that the problems of the sea would be a part of a general overall policy, featuring the industrial and technological guidelines for the exploration for minerals and the technological policy for underwater operations.

Now, the situation in French oceanological research is so far not at all clear according to Mr Giraud who recalled that several recent interministerial meetings were designed to make the situation clearer and to reorganize things here.

Concerning research in the field of multimetal nodules, the minister stated that manufacturers should not worry too much about any future profitability which is difficult to evaluate now and he suggested that they devote more funds to exploration and development of techniques in this field.

Regarding general research policy, the industry minister said that there were two types of research and that applied research does not necessarily spring from basic research, contrary to what people might think, but that these two activities are being developed side by side, with each benefiting from the other.

Program for Reform

Paris AFP SCIENCES in French 10 Jan 80 p 8

[Text] Paris. Coming oceanology reform. French oceanology reform drafts are to be published prior to the meeting of the new oceanology guidance committee on 21 January, it was indicated at the interministerial mission on the sea.

Oceanological research, according to government papers, is to be "broken down into sectors." Thus, four ministries would be responsible for the principal priority sectors: the Ministry of Transportation would be responsible for fishing and marine crop cultivation; the Ministry of Industry would be responsible for mineral and energy resources; the Ministry of Environment would be responsible for the marine environment; the Ministry of Universities would be responsible for basic and "exploratory" research.

The CNEXO [National Center for Exploitation of the Oceans] would be responsible for summarizing the activities in French oceanographic research and promoting intersectorial actions.

The interministerial mission on the sea would provide or would see to it that there is provided a secretariat of a COO (Oceanology Guidance Committee) whose chairmanship would by rights go to the chairman of the mission on the sea, Mr Aymard Achille-Fould, and whose vice-charimanship would go to the president of the CNEXO, Mr Gerard Piketty.

The COO would replace the Oceanological Research Council which would be dissolved after 3 years of existence.

In addition to the two personalities mentioned earlier, it would consist of four representatives from the ministries responsible for the program (industry, universities, transportation, and environment).

Moreover, the COO would have a representative from the delegation of innovation and technology within the Ministry of Industry, plus representatives from the ministries and secretariats of state concerned (Health, Foreign Affairs, Defense, Cooperation, Economy, Budget, Agriculture, Foreign Trade, Agricultural Food Industries, DOM-TOM [Overseas Departments, Overseas Territories]).

Finally, a representative from the DATAR [Delegation for Territorial Development and Regional Action], from the secretariat of research, and from the Office of the Commissioner-General of Planning should be included in that committee.

Officially, the reform of French oceanographic research would be designed to guarantee better coordination of programs adopted by the responsible ministries which would be free to allocate for applied and development research those budget funds would would "prolong" those coming from the research package as such.

These papers however have not yet been published and have raised many questions and produced comments from the various groupings. But the General Accounting Office in a recent report (see AFP/SCIENCES, No 199) has criticized the CNEXO on a certain number of points (competition among laboratories, no real choice as to programs, not enough coordination) which should influence the responsible officials in charge of instituting oceanological reforms and the CNEXO whose establishment in 1967 was designed precisely to coordinate oceanographic research.

5058
CSO:3102

POLICY FOR DEVELOPMENT OF OCEAN RESOURCES

Paris SEMAINE DE L'ENERGIE in French 10 Jan 80 p 6

[Text] France: Utilization of Ocean Resources

Oceanology has now entered a new phase according to Mr Andre Giraud, minister of industry, in presenting to the press an announcement on the utilization of ocean resources. This will be done hereafter according to the following principles:

The exploitation of hydrocarbon resources on the ocean bottom will be stepped up in national maritime zones; an effort in terms of technological development will be pursued to maintain the high quality of the French marine petroleum industry; the industrial structures of the petroleum-related sector will be strengthened within the context of industrial reinforcement actions adopted during the small cabinet meeting on 4 September;

The effort at prospecting and evaluating the deposits of multimetal nodules will be paralleled by the development of the technical means necessary for their exploitation;

The construction of the submarine SM-97, intended to operate at a great depth (6,000 meters), permitting access to all of the submerged surfaces, will be completed in 1982.

5058
CSO:3102

STUDIES ON USING OCEAN ENERGY FOR THERMAL POWER PLANTS

Paris AFP SCIENCES in French 17 Jan 80 pp 5-6

[Text] Paris. France planning to use energy from oceans. The warm oceans bordering on the overseas territories and departments could be used for the production of electric power, it is believed by the French government which is currently conducting research on this subject.

The technique to be used involves employing the temperature difference between the ocean bottom and the surface.

According to the French program, provision has been made for the study of the possibility to put up small thermal power plants with an output between one and ten Megawatts, a dimension which would minimize the technical problems. The new sections of nuclear power plants, it was recalled, attain an output capacity of 1,300 Megawatts.

These "mini-power plants" could be set up in the Antilles and in Polynesia but, for the time being, government experts are still involved in the technical study.

The government will decide as to whether to go into specific studies concerning the construction of these power plants only in the course of this year and this commitment will be influenced, the ministry of industry indicated, by the submission of offers based on private competition.

The construction of a pilot thermal power plant of several Megawatts, using energy from the ocean, will not be envisaged prior to the end of those research studies, in other words, in 1982 or 1983, according to the ministry.

5058
CSO:3102

MINISTER CRITICIZES GOVERNMENT ORGANIZATION OF R&D SUPPORT

Rome AVIAZIONE in Italian Dec 79-Jan 80 p 685

[Text] "Lack of an organizational legislative framework and an extremely small-time ministerial structure": these are the traits characterizing one of the public organizations of primary interest. We are speaking of the Ministry of Scientific Research and using the precise expression used by the Honorable Vito Scalia in a recent press conference to illustrate the status of his ministry and the need for interventions which will offer at least the possibility of establishing an organizational framework, more important than one which is operative. Beginning with observations on the particular status of the research policy in our country, Scalia expressed great concern over the dismal status of the Ministry of Scientific Research, a status which, in many instances, approaches the grotesque. Although it is difficult to speak of grotesque when the stake is called "search for health": at the time of his appointment, Scalia found "one, I repeat, only one person in charge." The minister continued by stressing that "to have tasks without a minimum of organizational structure means irreparably failing to carry out those tasks either through lack of precise initiatives which need to be taken within the organization or because time has run out on programs already begun with other European countries. My ministry is operating with branch personnel with no specific responsibility. Therefore, it is operating with 'indifferent personnel' and is in danger of dying from asphyxiation." And whereas for years it has lived almost "in a coma," this ministry has found a way to appropriate billions for programs still to be launched, for example, to include 600 billion in the 1977 budget through Law 675 which was to transform scientific research "from a minor episode into a constant of the country's economic development." There is no news of the 600 billion, except for about 30 billion invested at that time; nor has the minister been able to track down how the appropriation was used, although he guarantees implementation of Law 675 within a few months.

Stressing the atmosphere of desolation prevailing in the ministry, Scalia expressed a desire to strengthen the environmental, health and space departments and emphasized the need to extend the finalized plan to the administration of the transportation system. He then stated that more definite and operational use should be made of the CNR [National Research Council], which is existing "on a university scale, one composed of researchers and projects but without a complete picture of the various ramifications of research and without a specific purpose." The minister then dwelt for a while on the energy subject. After mentioning that the Council of Ministers recently approved the establishment of a work group for energy policy, a policy "which does not exist at the moment," Scalia stated that by next year a national energy program will be presented to CIPE [Interministerial Committee for Economic Planning] with the aim of putting the program into operation in 1981. The work group, composed of five members of the CNR, the CNEN [National Nuclear Energy Commission], ENEL [National Electric Power Agency], ENI [National Hydrocarbons Agency] and the INFR [National Institute for Financing Reconstruction], is to put together the sketch of a program of broad final effort toward research on the energy question with a very complete and exhaustive approach. To finance this research, we would resort to funds made available by the recent 50-lire increase in the price of gasoline. According to the minister, in the space domain, "we are seriously behind times due to a series of unfavorable circumstances which have caused us to miss out on excellent possibilities for collaboration on the European level, for example, with the TV-SAT system which the Germans subsequently perfected with the participation of the French." In this regard, he stated that for the Spacelab program, which views Italy as a partner in an international consortium of vast proportions, the requested appropriation of 100 billion is untenable in view of industrial returns of only 50 billion. Hence, the need to establish an Italian space organization with functions of coordination, control and administration of the space policy in which "we believe and for which our country is adequately prepared from a technological aspect." Alluding to the Sirio satellite, completely achieved in Italy, Scalia stated that considering the increase in financing from 180 to 200 billion obtained through a CIPE allocation, it has become possible to devise a program for a new Sirio II satellite which should catapult Italy to a highly respectable technological level in the field of telecommunications via satellite, creating premises for a third space plan on a higher level. However, at present the organization and operation of the Ministry of Scientific Research consist only of the press office and the office for finalized programs; the remainder is being developed conditionally. That is the research picture.

8568
CSO: 3102

RESEARCH MINISTER OUTLINES FUTURE OF SPACE PROGRAM

Rome AVIAZIONE in Italian Dec 79-Jan 80 p 684

[Article by Fabio Pagan]

[Text] Milan, October--"When I took over this ministry, I found the space plan discontinued for more than two years, awaiting the approval of CIPE [Interministerial Committee for Economic Planning]. I took steps to have it approved at once; otherwise, it would have become still older and would have risked emerging as a plan already out-of-date. CIPE took me seriously and increased the figure of 178 billion granted in May 1977 to 200 billion to compensate for inflation." This statement was made by the Honorable Vito Scalia, new minister of scientific research, outlining what he preferred to call a "synoptic plan" of his work before a solid group of Italian scientific journalists during an office visit to the Agusta di Costa factory.

It is a question--and Scalia made it a point to emphasize this--of an exacting but flexible plan. Two years from now, in 1981, the head of the Scientific Research Ministry will in fact have to appear before CIPE and give an account of the activity carried on and the manner in which the remaining 102 billion will be spent. For example, by 1981 we should be ready with the pilot model of the telecommunications satellite intended for operation at frequency ranges which are more advanced than those of the Sirio. If, by that time, the project is not obsolete in comparison with those realized in other countries, it will be further pursued and will become a full-fledged project. Otherwise, it will be cancelled. "Then," Scalia continued, "we should make the plan--including the finances--adequate for the requirement which will have emerged by that time, so that a new five-year plan will continue from the previous one." With regard to approval of the plan by parliament, Scalia indicated that there was no cause for doubt in view of the complicated arrangements made up to now in both the form of action and in the examinations to which it has already been subjected.

"After Sirio, Italy's space effort stopped to a certain extent," Scalia said. "Thus, we lost an opportunity to participate in the telecommunications satellite project carried out by the Germans, who preferred to reach an agreement with the French. But perhaps we can still enter into the collaboration agreement." To be precise, it is a question of the TV satellite project for which the German government offered Italy an opportunity to collaborate at the time, perhaps in exchange for participation by German industries in our 20-30 GHz satellite project (see AVIAZIONE issue 132). However, as Scalia asserted, the situation is now considerably more complicated. Naturally, the Sirio II satellite is still alive and will be put into orbit at no cost with the sixth launching of the Ariane vector, currently scheduled for 1981. Moreover, replying to a specific question, Minister Scalia denied the possibility that Italy might build a launcher of its own based on the American Acout: a kind of Superscout whose construction was mildly suggested as early as last spring by both Prof Luigi Broglio (directly concerned in the project) and the Honorable Giorgio Postal, who was under secretary for research in the administrations of ministers Pedini and Antoniozzi and who followed the Italian space policy with particular attention during the last few years.

However, the main point of Scalia's action appears to be the promotion of a space agency which can coordinate Italian activities in the national and international sectors. "I have currently given my collaborators the task of studying the statutes of the French CNES [National Center for Space Studies] and its counterpart in the FRG. I maintain that a similar agency is essential [in Italy]; I think it should be 51 percent owned by the state and the remainder by private industry." Finally, collaboration with the ESA [European Space Agency]. "We must strengthen our participation in the ESA. I met Dr Gibson, director general of the ESA, recently and told him our country cannot spend 100 billion for the Spacelab--as we have done up to now--and see only 30 come back in the form of industrial orders. Returns to our industries must be at least 80 percent."

1979-1983 Space Plan

CIPE, meeting on 25 October under the chairmanship of Budget Minister Andreatta, approved the 1979-1983 National Space Plan which calls for an overall expenditure of 200 billion. Moreover, CIPE approved Italy's participation in the ESA programs which will involve a financial commitment of 80 billion lire by Italy in 1980 alone. These are the principal objectives of the space plan: achieving and launching a preoperative telecommunications satellite on the 20-30 GHz frequency band; participation in international initiatives in preoperational experimentation in direct televised transmission via satellite and news broadcasts; development of systems of advanced propulsion and scientific and technological experiments on board Spacelab, the European space laboratory; and basic scientific and technological research.

The 200 billion appropriation has been divided into two financings: 98 billion for the 1979-1981 period and 102 billion for 1982-1983. The plan will be updated in 1981 based on the results of the three year plan and the remaining funds will be divided for successive activities. Thus, 52 billion are anticipated for telecommunications in the first three years (15, 16 and 21 billion respectively); for advanced propulsion, 7 billion (2, 2 and 3 billion respectively for the three years); for the European program of payloads on the Spacelab, another 7 billion (1, 3 and 3 billion respectively). Twleve billion (4 per year) are to be allocated for experiments to be carried out on ESA and NASA satellites or on stratospheric balloons. Moreover, 7 billion are scheduled for maintenance of the San Marco equatorial polygon, 6 billion for long-distance reconnaissance and 7 billion for feasibility studies of future projects.

8568
CSO: 3102

ITALY

PROSPECTS FOR ALTERNATIVE SOURCES OF ELECTRICAL ENERGY

Rome FONTI DI ENERGIA ALTERNATIVE in Italian Jul-Aug 79 pp 37-48, 50-53

[Article by L. Paris, director of ENEL (National Electric Power Agency) Studies and Research Center, and G. Castelli, assistant director of ENEL Studies and Research Center: "Outlooks for Development of New Sources for Production of Electrical Energy"]

[Text] Introduction

The purpose of this report is to give indications about the role that new energy sources can foreseeably play in meeting the needs for electrical energy at the beginning of the 1990's, which in practical terms corresponds to the time horizon of ENEL's present operational programs. By new sources, we mean those of interest for production of electrical energy that are not yet used on an industrial scale--that is, solar energy, wind energy, the energy obtainable from urban wastes and agricultural residues, and the energy obtainable from the sea.

Some of these energy sources are of considerable interest, at least in their potential state, and this is the main reason for the notable commitment that ENEL is making to the sector and for the numerous study, research, development and demonstration programs started by ENEL several years ago now and gathering momentum.

Nevertheless, anticipating and summarizing the considerations and conclusions presented in the various sections of the report, it seems important to underline the fact that throughout the world, the state of development of the technologies for utilization of solar and wind energy is, at least as regards production of electrical energy, in an initial phase, and that in general we are still far from obtaining competitive performance characteristics, even in a situation of sharp increases in the prices of fossil fuels.

The times needed for overcoming the technical and economic problems that still impede the attainment of the objective and the times needed for acquisition of the necessary experience, to be obtained through the functioning of prototypes and demonstration plants, are rather long, no matter how rapid or successful the technological development may be.

It follows from this that in 1990, the contribution of these sources to fulfillment of Italy's needs for electrical energy can only be very modest--corresponding, that is, to a few tens of MW of power, mainly from wind sources in plants largely of experimental characteristics.

This contribution should take on growing importance, but still modest with reference to the totality of the problem, in the 1990's.

Urban wastes and agricultural residues converted with high efficiency into electrical energy in thermal power plants could make a bigger contribution, but still a very marginal one, to meeting electric-power demand if several technical and environmental problems under study today, and especially the organizational problems connected with the collection and storage of these energy materials, were solved.

These last-named problems, together with the uncertainties as to other possibly more suitable uses for these materials, make it impossible at present to specify quantitatively the contribution that they will bring to the electric-power sector.

On the other hand, the use of energy from the sea as a source for production of electrical energy seems to be totally out of the question because of the very thin energy density of the motion of the Mediterranean Sea and its modest thermal gradients.

An indirect contribution could also derive from diffusion of solar panels for production of hot water, which, among the various applications of solar energy, is the one closest to competitiveness; diffusion of these panels could in fact reduce demand for electrical energy for heating of water essentially for domestic uses. Even on the assumption of widespread diffusion of the panels, which from the point of view of rational use of energy is certainly to be hoped for and encouraged, the reduced demand for electrical energy, though considerable from an absolute point of view, would still be marginal from a percentage point of view, even in the medium-term outlook.

Solar Energy

1. Availability and Characteristics of the Source

Solar energy certainly represents the most widespread renewable energy cource, available everywhere in very large quantity. In this last regard, it is sufficient to realize that a quantity of energy equal to bout 200 to 250 times the present total national energy needs falls on Italian soil from the sun every year; thus, taking into account the efficiencies of conversion of solar energy into usable energy, a few percent of the national territory would be sufficient to have enough energy in terms of quantity (but not quality) for current rates of consumption. Furthermore, solar energy is distributed on Italian territory in a relatively uniform manner, it does not pollute, and it is free.

These unarguably advantageous characteristics of solar energy might lead one to believe that it is capable by itself of solving our country's energy problems: but this unfortunately is not the truth, at least in the short and medium term, inasmuch as there is still a big gap between the potential capacities and the practical possibilities for utilization.

Along with the positive aspects mentioned, solar energy actually has several unfavorable characteristics. The incident energy per unit of surface area is very low: on the average, the solar energy available per year on 1 square meter of Italian territory has an energy content corresponding to 1,100 to 1,500 kWh thermal, depending on the locality, with a daytime available thermal flow varying from 0 to some tenths of 1 kW thermal per km^2; for a term of reference, it can be recalled that the meand thermal flow in a boiler is on the order of 100 kWt/m^2.

The low density of solar energy represents a considerable disadvantage in that it becomes necessary to use vast surface areas to collect and convert the incident radiation, and large collection areas are generally synonymous with high installation costs.

A second considerable disadvantage of solare energy is its discontinuity, owing to the alternation of day and night, the cycle of the seasons (the energy available in December can, in our latitudes, be 5 to 7 times less than that of July), and the variations of weather conditions. This discontinuity of solar energy has negative economic consequences: for all applications that require a certain continuity of supply, they must be coped with either by means of energy storage systems or by integration with plants that use energy sources other than solar energy. Both approaches entail economic burdens that can be heavy enough to reduce considerably the value of the solar energy utilized.

2. Applications of Solar Energy

As is well known, the principal possible applications of solar energy--to prescind from those fundamental ones that are at the basis of life on our planet--are the following*:

--production of low-temperature heat--lower, that is, than 80° to 100° C--essentially for heating of water for domestic or industrial uses and for space heating;

--production of medium- and high-temperature heat for industrial uses (process heat, conversion into mechanical energy, production of electrical energy);

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* The use of solar energy for production of biomasses is not included because it is considered the the subject of biomasses, albeit of considerable interest and importance, does not come under the theme of this conference, which is aimed at the means that make it possible to produce electrical energy directly, rather than via production of fuel.

--direct production of electrical energy by the photovoltaic process.

ENEL is carrying out research, development and demonstration programs in practically all the fields of application of solar energy. Nevertheless, in view of ENEL's institutional purposes, the programs of greatest importance are those aimedat the utilization of solar energy for production of electrical energy, even though, among the various applications of solar energy, these are among the farthest from economic competitiveness, at least under the conditions that prevail today in an industrialized country such as Italy.

In the following pages, ENEL's principal research, development and demonstration programs in the solar sector will be reviewed in outline, and the state of development and the technical-economic outlooks for the various specific applications of solar energy will be discussed briefly.

3. Low-Temperature Thermal Applications of Solar Energy

As is known, the principal low-temperature (below 100° C) thermal applications of solar energy are the production of hot water and space heating by the use of solar panels and, in the case of room air-conditioning, by means of passive architecture--that is, by siting and designing buildings in such a way as to maximize solar energy's contribution to the air-conditioning process.

The application that is closest to economic competitiveness, or in certain situations may already be competitive, as regards the use of electrical energy, is the production of low-temperature hot water for industrial uses and for uses in the civil sector by means of solar panels. In this regard, it should be kept in mind that the economic characteristics of a solar system for hot-water production depend on many factors--for example, the cost and technical characteristics of the panel; cost of installation of the system, which in turn can vary in function of the characteristics of the building and its state (in design, under construction, or occupied); duration of the panels; the sunshine received by the locality where the system is installed; the cost o money; the price of the energy competing with solar energy; the pattern of hot-water demand (which helps determine the storage capacity required); the price of any energy integrated with the solar energy; and so on.

The large number of factors that play a part in evaluation of the economic characteristics of a flat-panel solar system and the wide range of variability of each of these factors demonstrate clearly the difficulty, if not the impossibility, of establishing in a general way the competitiveness of solar energy for production of hot water' in the present state of the art, however, it can be considered that among the many possible situations, there are several, resulting from actual combinations of the factors listed above, in which the use of solar energy can be competitive already or close to competitiveness. The use of solar energy for production of hot water serves to take the place of highly valued energies and energy forms, such as electrical energy and gas, and should therefore be encouraged. In various countries in the world, including Italy, there is a solar-panel production industry which, though it has already advanced beyond the small-scale workshop phase, has not yet crossed the threshold that leads to commercialization and industrialization of the product. This is so for various reasons, the first of which is the limited demand.

Hence the advisability and necessity of incentives from the state sufficient to overcome the initial inertia and thus get the cycle going: increased production of panels - reduction of costs - increase in demand for panels. Various bills introduced in the last legislative session provided for incentives, in the form of tax relief, to use of solar panels for production of low=temperature heat. ENEL has always been in favor of this, and even declared that the incentives proposed were insufficient and should thus be increased. In the present state of affairs, it is difficult to state an opinion on the foreseeable market penetration of solar panels for production of hot water; however, even though it is to be hoped for, it seems logical to consider that it will be rather slow, at least in the initial phase, which at first will develop in new building and could spread gradually with improvement in competitiveness and with decrease in installation costs, as the public gradually acquires confidence from the point of view of reliability and from an economic point of view.

What might the consequences of this expansion be as regards electrical energy? It is presently estimated that about 8 to 9 percent of the electrical energy consumed in Italy is used for production of hot water for domestic uses (hot-water heaters, dishwashers and washing machines) and for the tertiary sector, at temperatures that can be supplied by common solar panels; this is a use which, while appropriate from the point of view of reduction of the costs of household electrical appliances and the convenience of the user, certainly is not advisable from the point of view of conservation and rational use of the primary energy sources.

On the assumption that solar energy can within 15 to 20 years meet one-fourth of this demand, consumption of electrical energy could be reduced in this way by a quantity on the order of 2 to 3 percent of total demand.

Less promising, though, in the present state of affairs, are the prospects for use of solar energy for space heating. As is known, this is an extremely important application from the energy point of view in that it accounts for about one-fifth of the country's total needs. Unfortunately, solar energy's competitiveness gap for this application is still a wide one, and it will probably be possible to close it only if in the future--as is foreseeable, for that matter--there are considerable increases in the price of the traditional energy sources.

Nevertheless, we shall not undertake an examination of the use of solar energy for space heating, despite the very heavy influence of space heating on the national energy balance-sheet, essentially because, while the hoped-for diffusion of solar energy for this application could considerably reduce consumption of petroleum derivatives, gas-oil in particular, it would nonetheless have a strictly marginal influence on consumption of electrical energy. Indeed, as is known, in Italy, unlike other countries, the diffusion of electric heating has been very limited, and consumption of electrical energy for this purpose is very modest, even though it can produce problems in the operation of the system because, in general consumption is concentrated in the periods of lower environmental temperature.

In the field of low-temperature thermal applications of solar energy, ENEL has carried on promotional activity and research and demonstration activity, and continues to to so.

In this regard, ENEL has built several solar installations for production of hot water and for space heating--for example, at Rossano Calabro, near its own Rome headquarters, at Como, Reggio Calabria, etc--and it has others programmed.

We shall limit ourselves here to reviewing the characteristics of one of these installations, that of Rossano Calabro. It is a heating and hot-water production plant using solar collectors, with nighttime electric-power integration, installed in one of two small twin apartment houses for the ENEL personnel of the Rossano Calabro power plant, and a comparison plant, powered totally by electrical energy and provided with a storage tank, has been installed in the second apartment house. The principal characteristics of the installation are presented in the following table.

Experimental Installation of Rossano Calabro

Apartments per apartment house	6
Total floor area	2,640 m^3
Surface area of panels	130 m^2
Internal design temperature	20° C
External design temperature	2° C
Daily production of hot water (50° C)	6 X 150 liters
Electric power for integration system	74 kW
Ratio of solar energy to heat needs	0.55

The installation is equipped with systems for measuring and recording meteorological data, as well as data relating to its own functioning, in order to evaluate the installation's technical and economic performance characteristics and the contribution of solar energy to meeting the demand, and to study the characteristics of the withdrawal of the integration energy so as to evaluate the effects on the electrical system.

In the area of promotional and research activities relative to thermal applications of solar energy, it should also be mentioned that ENEL has accepted the EEC's invitation to build the Italian test station, which is part of an EEC network of eight test stations for validation of mathematical models of solar installations for space heating and, in the case of the ENEL station, for air-conditioning also. This installation, which is presently at an advanced stage of construction and will be located in Catania, will be able to play an interesting and important part in effective and rational evaluation and designing of solar installations for room air-conditioning.

In the area of thermal applications of solar energy, ENEL assigns considerable importance to an initiative taken by two of its institutes, the CESI and the CISE [expansions unknown], in the second half of 1977--that is, the establishment of a Research Society, the Phoebus, which works in the solar field exclusively.

Phoebus, with headquarters in Catania, employs experts and qualified researchers in the solar field and is currently completing the initial phase of organization. The fields in which Phoebus proposes to work are the following:

--outdoor testing to determine characteristics and conformity to specifications of solar systems for thermal or photovoltaic conversion plants. Modifications and development to the customer's order. Assistance with installation and startup. Periodic checks during operation;

--development of knowledge and experimental activity to permit increasingly large capacity for advance judgment on time-span reliability of solar components;

--studies for application of systems using low-concentration collectors and/or heat pumps, applications to solar air-conditioning. Management, on ENEL's behalf, of the test station for validation of the calculation models, as mentioned above;

--consultation activities, consisting of feasibility studies, cost-benefit studies, assessment of solar systems, of solar installations and of development programs in the solar field;

--research and development on commission, with particular regard to the passive-systems field, to production of mechanical and/or electrical energy, to agricultural applications, to desalination of water.

Through the Phoebus Society, which is open to participation by institutions and industries interested in solar energy, and which will operate in Italy and abroad, ENEL believes it can make an important contribution to development of the low-temperature thermal applications of solar energy.

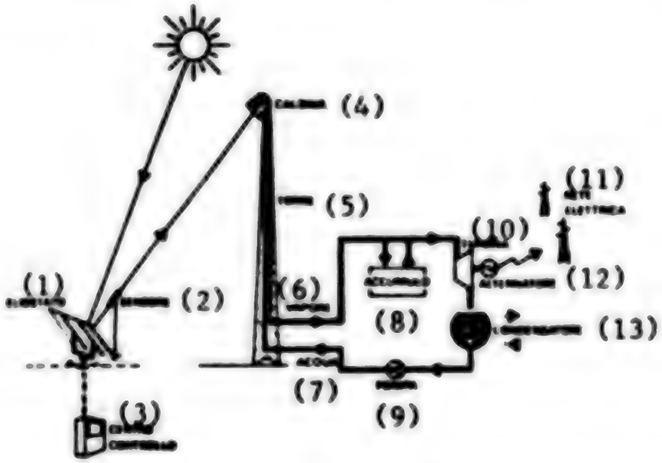
4. Production of Heat at High and Medium Temperatures for Conversion of Solar Energy into Electrical Energy

As is known, by concentrating solar rays it is possible to obtain thermal energy at high temperatures that permit production of mechanical energy and electrical energy with satisfactory conversion efficiencies. The systems that can be used for this purpose fall into two broad categories: the plants with central collector and mirror field, and the distributed-type plants.

ENEL is heavily involved in development of both these types of plant, even though--as will be discussed more fully below--the electrical energy produced by them costs, in the present situation and in the foreseeable short and medium terms, several times as much as the energy produced with traditional plants.

ENEL's principal program in the field of solar power plants with central collector is the one that provides for construction, by the end of 1980, or a plant with power of 1 MW at Adrano in Sicily.

The operating principle of these power plants is well-known, and is represented diagrammatically in the figure below; the solar radiation is reflected by a number of heliostats that automatically follow the track of the sun, so as to concentrate the reflected radiation onto a boiler placed on a tower. The boiler at Adrano is of the water type, and the steam generated in it powers a turbine.

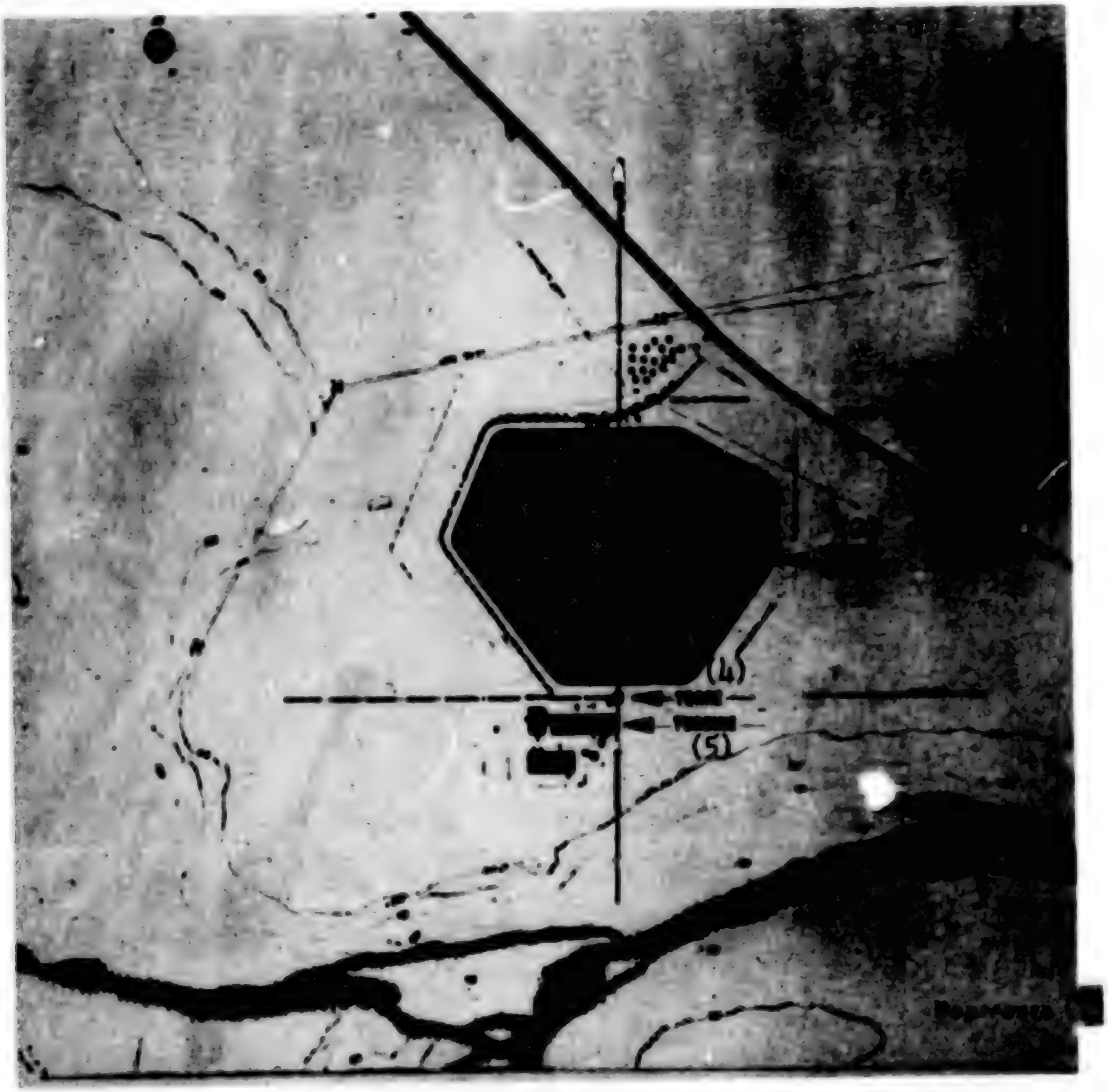


Operating diagram of solar power plant with central collector and mirror field

Key :

1. Heliostat
2. Sensor
3. Control center
4. Boiler
5. Tower
6. Steam
7. Water
8. Storage
9. Pump
10. Turbine
11. Electric-power grid
12. Alternator
13. Condenser

Italy boasts a long tradition in the field of solar power plants of the tower and mirror-field type, thanks mainly to the pioneering work of Professor Francia and to the building of the Santo Ilaria experimental plants by Professor Francia himself.



Plan of the Adrano solar power plant

Key:

1. Road
2, 3. Mirror field
4. Tower
5. Turbine
6. Simeto River
7. Contrast

The Adrano solar power plant will therefore be the first European solar power plant of the central-collector type, and probably also the first one in the world. The project is part of an EEC program and is being built through Italian-French-German collaboration. The installation has been designed and is being built by an industrial consortium whose members are Ansaldo and ENEL, for Italy, Cethel for France, and Messerschmidt-Bolkow-Blohm for the FRG. The power plant will be the property of ENEL and the EEC, and will be connected to the national grid; operation will be by ENEL.

Construction of the plant will be completed by the end of 1980. The design work is practically finished, the main components are being manufactured, and the preliminary on-site construction work has been started.

Installation components representing one-third of the plant's value are being built in Italy, and the remaining two-thirds worth are being built in France and the FRG.

The design work is the consortium's responsibility, with specific tasks assigned to the consortium's components; ENEL in particular is responsible for --in addition to the infrastructures, general services and civil-engineering work--study of the dynamic behavior of the plant and of the system for control and regulation of the secondary cycle.

The figure preceding shows the general arrangement of the plant, and the figure following shows a model of the plant on the scale of 1:150.

The table below presents the principal characteristics of the plant.

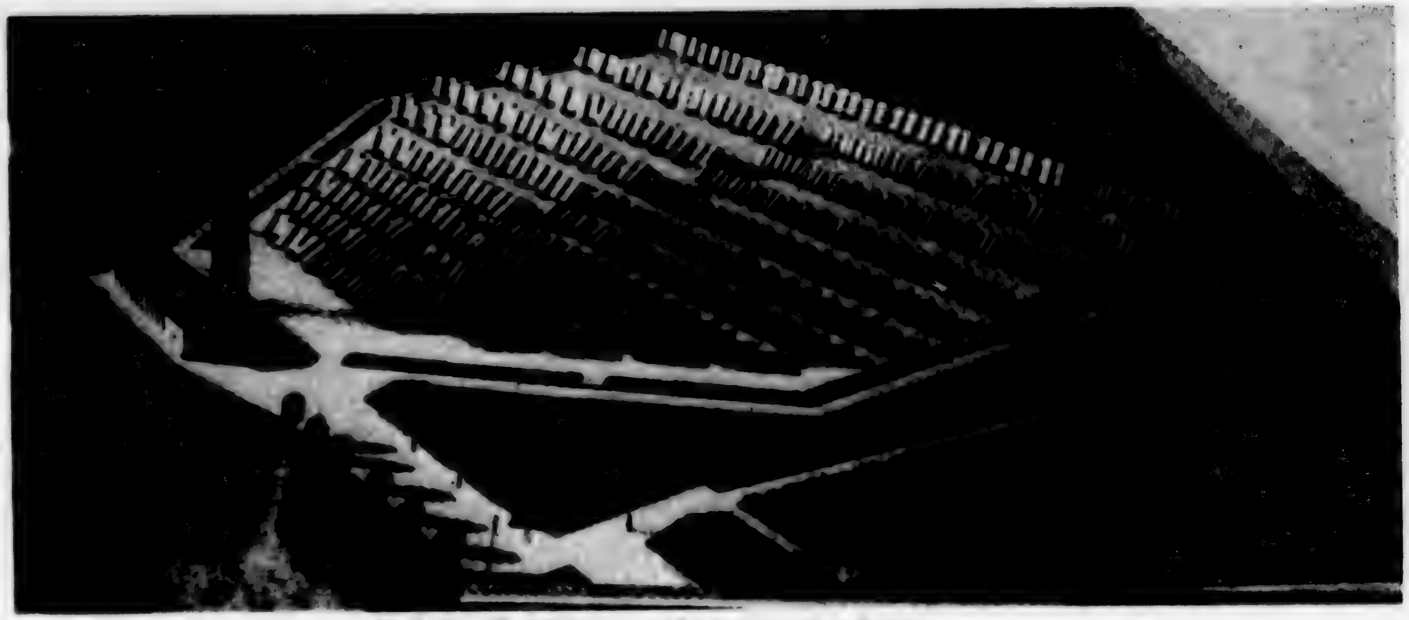
Principal Characteristics of the ENEL-EEC Solar Power Plant of Adrano

Nominal peak power	1 MW
Overall efficiency	16 percent
Total surface area of mirrors	6,200 m^2
Area required by power plant	35,000 m^2
Steam flow	4,700 kg per hour
Steam temperature	510° C
Steam pressure	64 kg per cm^2
Height of tower	50 m
Storage capacity	30 minutes

The solar boiler, which is one of the most technologically advanced parts of the plant, has been designed by Professor Francia and is being built by Breda-Ansaldo.

Half of the cost of the plant will be borne by the EEC; the remainder will be divided into three parts, one of which will be borne by Ansaldo and ENEL, which will also furnish the site and several infrastructures.

The cost of the Adrano power plant is on the order of $10 million, at 1977 values. This is an extremely high cost (8 to 9 million lire per kW of peak power for an annual production of 1,500 to 1,800 kWh for each peak-power kW); but on the other hand, it is no higher than for similar plants under



Model of Adrano solar power plant

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construction or being designed in other countries. It follows from this that the cost of the electrical energy produced by Adrano will be several tens of times higher than that of the electrical energy produced by traditional means.

This can be justified at least in part by the fact that the Adrano power plant is a prototype, and like all prototypes has a high cost that results from many factors--among them the limited experience so far acquired, the adoption of solutions that are not optimal from the economic point of view,possible conservatism in the design, and so on. In any case, the fact remains that in order for power plants of the Adrano type to be able to become competitive in the Italian situation, not only a substantial reduction of the cost will be necessary but also an equally substantial increase in the prices of the other energy sources.

This conclusion might not hold true, though, in certain zones of the world where there are very special local factors, such as, for example, very high costs for the traditional energy sources and great distance from the electric-power grid.

In any case, ENEL considers it advisable and necessary to devote a heavy commitment to these applications, inasmuch as the experience that will be acquired with Adrano will be of notable importance, both for getting the technical-economic outlooks for solar power plants of the central-collector and mirror-field type into better focus and for establishing Italy's credentials in this sector abroad. The usefulness of Adrano in this regard could eventually prove greater because of the fact that after a certain time of operation as a producing power plant, the installation will very probably be used as a test station for large components, solar boilers in particular.

In any case, with reference to the time span that is being considered by this conference--that is, for the next 10-12 years--it appears logical to conclude that the contribution of solar power plants of the central-collector type to filling the electric-power needs can only be a marginal one, inasmuch as it seems improbable that this type of power plant can in the space of 10-12 years reach the phase of commercial application, at least under conditions that are valid for an industrialized country such as Italy.

In addition to the Adrano power plant and participation in the proposal and design work for the Spanish power plant of the central-collector type at Almeria, ENEL's programs also plan for the building and testing of solar generators of the low-power thermodynamic type--that is, from a few kW to a few tens of kW. These generators, of the parabolic-cylinder type or of the paraboloid type, will be used with appropriate storage and/or integration systems for supplying power for uses not yet connected to the electric-power grid and with particularly high connection costs. For usages of this type, it is desired to test, from the technical and economic points of view, the advisability and suitability of small generators. This ENEL program is finishing its initial phase, and should be followed very shortly by the building of the first actual installations. It is expected that this will occur within the framework of the Italy-United States bilateral agreement on solar energy, which is about to be signed, and which among other thins provides for the construction in Italy by ENEL, in close collaboration with industry, of a small solar power plant of about 40 kW, 20 kW of which will be of thermodynamic type and the remaining 20 kW of photovoltaic type.

The costs of these prototypes, as well as of the energy produced by them, is very high today, and in the present state of the art, it appears premature to express an opinion on the possibilities of these systems for achieving competitiveness in situations valid for Italy. Nevertheless, even postulating that the distributed solar systems manage to become competitive for supplying power for Italian usages not yet connected to the grid and with the highest connection and power-supply costs, it is obvious that these systems' contribution to fulfillment of the needs for electrical energy can only be marginal, considering their very low unit power and the relatively small number of usages that could lend themselves to this purpose.

5. Production of Electrical Energy by the Photovoltaic Process

As is well-known, it is possible by means of the photovoltaic effect to convert solar energy directly into electrical energy by means of the generators known by the name of solar cells.

In the last 20-25 years, development of solar cells has been given a very big push by the space programs. In recent years, there has also been further and very important progress by virtue of the programs dedicated to development of solar energy for meeting energy needs, and today the use of solar cells for very special applications (power supply for radio relays, for Alpine shelters and small islands, etc) can already prove competitive.

For applications of traditional type, however, competitiveness is still a long way off: the cells presently have costs on the order of $10,000 per kW of peak power, which is far higher than the target that the Department of Energy of the United States, which is the country most heavily involved in this sector, has set itself for the middle of the 1980's--that is, the making of solar cells at a cost of $500 per kW of peak power. In addition, it will be necessary to achieve very big reductions not only of the cost of the solar cells but also of the cost of all the apparatuses, structures and auxiliary parts that go together with the solar cells to form a photovoltaic power plant. In this regard it is important indeed to note that the cost of these parts (support structures for the cell panels, connections and wiring, electrical devices for conversion from direct current to alternating current, etc), if of traditional type and design, have a considerable effect on the cost per kWh produced: even at a cell cost of $500 per kWp, the cost of the electrical energy produced would still be on the order of 100-150 lire per kWh.

To arrive at competitiveness, it will therefore be necessary to achieve not only considerable technological progress in the making of the solar cells but also a notable contribution of imagination and innovation in the design and construction not only of the cells but also of the other parts that go to make up a photovoltaic power plant.

ENEL is active in the photovoltaic field through direct research action for development of advanced-type solar cells, through promotion of the research and development activities of the Italian industries, through the carrying-out of feasibility studies, and through a program of installation and testing of photovoltaic power plants with powers ranging from a few kW to a few tens of kW.

As regards direct research activity, ENEL has been using one of its research institutes, the CISE, for some time. The program concerns development of photovoltaic cells, with advanced performance characteristics, of the gallium arsenide and gallium-aluminum type, to be used for high concentrations of solar radiation. The first cells produced, which have been tested with concentration up to 1,000 suns, have shown a low-temperature efficiency of about 21 percent, a value very close to the theoretical one and quite a bit higher than that of the silicon cells; the behavior of the cells at the higher temperatures is considered satisfactory also.

For 1981, it is planned to build a small photovoltaic power plant of 1 kW, of the type with concentration by gallium-arsenide cells and with recovery of the thermal energy produced by the cells.

In addition to the research carried out through the CISE, ENEL has participated--and is still doing so--in the programs of the CNR [National Research Council] and the EEC with execution of feasibility studies and of preliminary proposals for photovoltaic power plants of low and medium power.

In particular, after carrying out a study on behalf of the CNR regarding the general proposal for a photovoltaic plant of 10 MW_p, ENEL is completing--on EEC contract and in collaboration with Ansaldo, the Officine Galileo and the CISE--an investigation of the technical-economic feasibility of a power plant, with power of 1 MW_p, using low-concentration silicon cells. With reference to small-size photovoltaic power plants, ENEL is taking part in research and demonstration activity along two distinct lines. On the one hand, in collaboration with all the principal national industries involved in promotion of the photovoltaic sector, ENEL is carrying out a coordinated research program to last seveal years, the purpose of which is to raise the competencies and qualifications of the Italian industry, putting it in a position to participate, with adequate productive capacities, in the considerable photovoltaic construction program which the EEC will propose in the early 1980's. This coordinated program is aimed at development of photovoltaic units with power from a few kW to several tens of kW, to be used, with suitable means of storage and/or integration, for supplying power to usages not connected to the grid and with particularly high connection costs. On the other hand, within the framework of the Italy-United States bilateral agreement already referred to, ENEL intends to build two small solar power plants of 20 kW--one of the photovoltaic type and the other of heliothermoelectric type--as well as a small plant with power up to f kW_p, using silicon cells without concentration, to power remote usages located in southern Italy.

As regards the prospects for the future, there is no doubt that the photovoltaic sector is now developing strongly and is characterized, more than other solar sectors, by a greater possibility of innovation and radical progress. On the other hand, under the conditions that generally prevail for our country, the commercialization of solar power plants, of both low and medium power, appears to be a still distant objective.

It should therefore be concluded that the contribution of photovoltaic plants to fulfillment of the Italian electric-power needs of 1990 will be a very modest one, even on the assumption of a certain diffusion of small photovoltaic power plants for supplying electric power to Italian usages with the highest connection and power-supply costs.

Wind Energy

1. Characteristic and Availability of the Source

Among the renewable energy sources, wind energy is the one which, in the present state of its technology, seems closest to competitiveness with the traditional sources for production of electrical and mechanical energy, at least at those sites that have favorable anemological characteristics.

Wind energy is clean and very widespread, and has the advantage over geothermal and solar energy that it is available in mechanical form (and is therefore easily transformable into electricity).

The quantity of wind energy available is theoretically very large; however, the utilization of this type of energy is strongly limited by its low energy concentration and by marked irregularity and inconstancy. Finally, it should be exmphasized that the energy of the wind does not lend itself to direct storage.

The result of these negative characteristics, and especially the low energy density of wind, is that wind plants must be of very large size in relation to their power (a 1-MW generator has blade diameter on the order of 50-60 meters), and at the same time must have high mechanical resistance in order to bear the stresses induced by exceptional winds of considerable force.

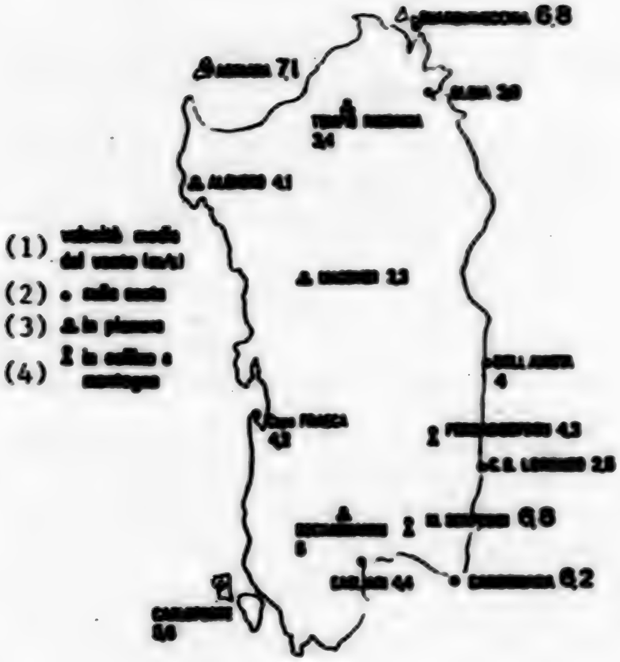
In contrast to solar energy, it is very difficult and complex to make a quantitative estimation of the wind energy potentially obtainable in a given country.

With solar energy, interpolation of the sunshine data of a certain number of weather stations makes it possible to calculate, at least in rough approximation, the quantity of solar energy available in the zone covered by the stations in question, even if the zone is a very large one.

This does not hold true for wind energy, inasmuch as the energy produced by a wind generator depends largely on the anemological characteristics (and in particular, the pattern of wind velocities) of the exact place in which the generator is installed, and the anemological characteristics in a specific spot and at the relevant altitudes for a wind generator are very heavily influenced by local orographic characteristics.

Therefore it is not very meaningful to refer to data recorded at some distance from the site in question.

For Italy, there is not yet an adequate data bank of the country's anemological characteristics, even though action has been in progress for some time, especially within the framework of the CNR. Nevertheless, extremely general indications can be obtained by using the data of the weather stations of the Italian Air Force.



Average wind velocities, at 10 m above the ground, for several weather stations of Sardinia (decade 1960-1969)

Key :

1. Average wind speed (meters per second)
2. On the coast
3. On a plain
4. On a hill or mountain

The figure above shows, by way of example, the average wind value as calculated over a decade in several zones of Sardinia, which, among the various Italian regions, is the one that seems to present the most interesting anemological characteristics. The most frequent average velocity is around 4 to 5 meters per second, with peaks upt to 6 to 7 meters per second only in exceptional cases. Nevertheless, the maximum velocities on the basis of fwhich the wind engines must be sized, for safety purposes, are similar to those necessary for far windier sites.

The data cited and another indications, again obtained from Italian Alir Force data, show that from an anemological point of view, our country does not appear expecially fortunate. The fact is that comparison with the analogous data for other European countries indicates that there are vast zones in Europe that offer considerably more interesting possibilities for utilization of wind energy. This is true especially for England, Denmark and Sweden, where there are coastal area of large breadth with average wind velocities of 7 to 8 meters per second and even more.

If one keeps in mind the fact that the power of a wind generator is proportional to the cube of the wind velocity, one understands why the economic and technical performance characteristics of a wind generator depend heavily on local anemological conditions; it is sufficient to realize that about 50 W per square meter of effective blade are can be obtained from a wind of 5 meters per second, while with a wind of 8 meters per second, the power rises to about 200 W per square meter of effective blade area.

2. The State of the Art

The utilization of wind energy for production of electrical energy has already, in several countries with excellent anemological characteristics (Denmark, United States, etc), been the subject of research and development programs, later abandoned at times well before the energy crisis. The energy crisis and the need to deversify the primary energy sources have in recent years, and in many countries, given a big push to research and development in the field of wind energy. As regards production of electrical energy, the objectives are on the one hand the development of competitive wind engines of low power to supply isolated usages, and on the other hand, development of large-size wind generators connected to the grid. Considerable attention is being devoted also to development of engines for conversion of wind energy into mechanical energy for applications essentially in the agricultural field, and for several such applications (for example, the raising of water for irrigation uses), the use outlooks appear interesting.

As regards large-size helioelectric generators, it can be deduced from the studies and programs under way in various countries that optimization from the economic point of view will lead to generators characterized by blade diameters on the order of 60 to 80 meters, and therefore with powers on the order of 1 to 2 MW.

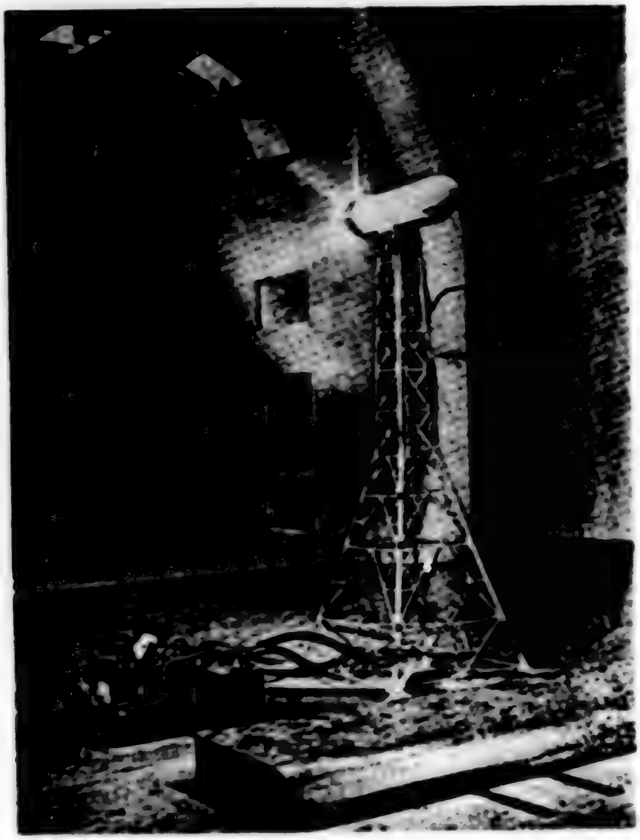
It is therefore obvious that in the field of wind energy, the phase of experimentation is not very advanced, and operating experience is limited in time and has been only with a few prototypes of modest power. It is also obvious that in this phase of development, specific and reliable data on the economic and technical performance characteristics of wind engines are not yet available.

Finally, it should be stressed that because of the great irregularity of the wind, it is not possible, in practical terms, to count on a power contribution from wind engines; therefore they should be considered substantially as economizers of fuel.

3. The ENEL Program

ENEL's interest is aimed at development and testing, in collaboration with the national industry, of wind engines of medium and large size to be connected to the electric-power grid.

ENEL's research program provides, in its initial phase, for acquiring construction, operation and maintenance experience with this type of plant, by the building of a wind power plant composed of a group of 10 wind engines, some with 2-blade rotors and some with 3-blade rotors, with rotor diameter of 13-18 meters, installed in plain country. and one or two isolated wind engines of the same size, installed on the peaks of high country that is especially well-exposed to the wind.

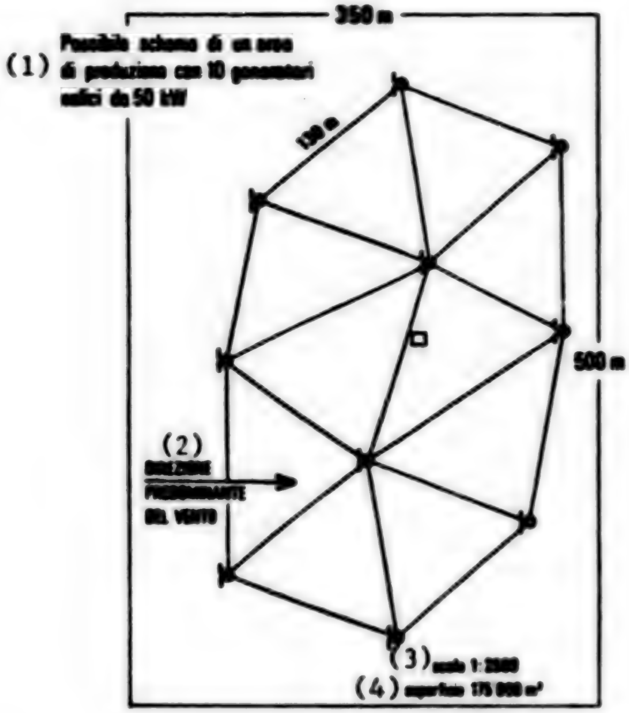


Model of FIAT 50-kW wind engine being tested in wind tunnel

The unit power of these wind engines, which will be built by Italian industry (see figure above), is about 25-50 kW, on the basis of a wind velocity of 10 meters per second.

The 10-unit power plant will make it possible, among other things, to have alternative systems for arrangement of the wind engines within the production area, in order to check the possible interactions among the wind engines themselves (see figure on following page).

In the case of arrangement in flat areas, the power density that can be achieved on the most favorable sites is less than 10 MW per km^2. With these low levels of land use, it is obvious that in Italy, other uses (agricultural, industrial, residential) would have to coexist with them, and for this reason, anemoelectrical production may be conditioned by environmental restrictions (impact on landscape, noise, safety, etc).


350 m
(1) Possibile schema di un area di produzione con 10 generatori eolici da 50 kW
130 m
500 m
(2) DIREZIONE PREDOMINANTE DEL VENTO
(3) scala 1:2500
(4) superficie 175 000 m²

Possible pattern of a production area with 10 wind generators of 50 kW each

Key :

1. Possible pattern of a production area with 10 wind generators of 50 kW each
2. Prevailing wind direction
3. Scale 1:2,500
4. Surface area: 175,000 m^2

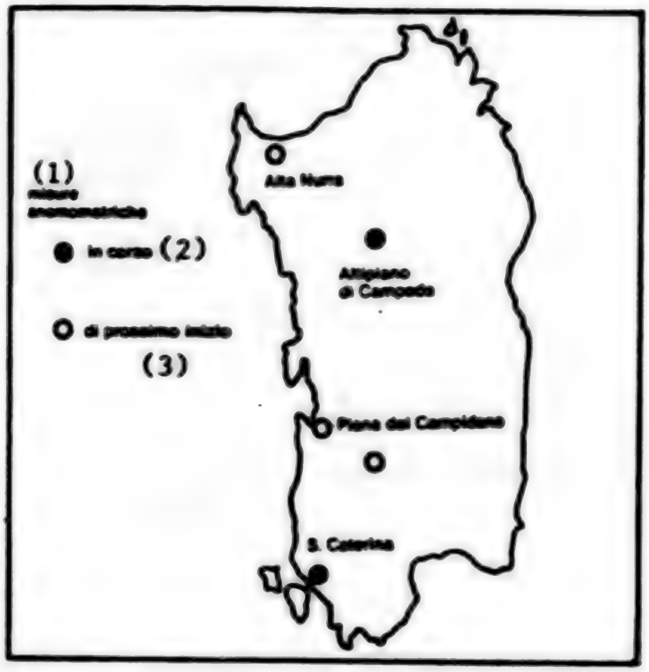
In order to acquire experience on the environmental impact of wind power plants, ENEL's research program provides, among other things, for:

--desing of the forms of the wind engines and their related support structure so that they are esthetically compatible with the environment;

--evaluation of the possibilities of exploitation for other purposes of the land surrounding the point of installation of wind engines, with adherence to the proper safety standards;

--analysis of the noise produced by wind engines in rotation, and development of design and installation criteria for minimizing it;

--determining whether there are any disturbances of radio and television transimissions due to the electromagnetic waves reflected from wind engines as they rotate.



Sites considered for installation of the wind power plant

Key :

1. Anemometric measurements
2. In progress
3. To be started soon

In the light of the experience acquired with the medium-size wind engines, it is planned, in the second phase of the program, to perfect large-size wind engines with rotor diameter of about 60 meters and powers on the order of 1 to 2 MW, for which sizing studies are already in progress, in collaboration with Italian industry.

The whole of these research and demonstration activities forms part of an articulated project designated "Project VELE (Wind for Electricity)."

ENEL has specified in Sardinia, by agreement with the Sardinia Region and with the collaboration of the University of Cagliari, three possible localities (see figure above) in which to build the 10-unit wind power plant. In these localities, stations for recording the wind characteristics have already been installed for several months, so as to be able to make interpolations with the data from the closest Italian Air Force stations.

The definitive choice of the site is planned for the end of October, and the power station should go into operation within a year.

4. Prospects for 1991

As has been said, the demonstration and research activities in progress within the framework of Project VELE will furnish the elements necessary for formulation of the specifications and for design and construction of the large-size prototype (on the order of 1 to 2 MW), which presumably will go into operation by 1985.

In parallel, in collaboration with the CNR and with all interested parties, the activities necessary for establishing an adequate data bank on the local anemological characteristics of the most interesting zones of the national territory will be continued.

This action, together with the experience acquired with the program of actual construction already begun, will furnish the necessary elements on which to base a program of development and industrial production of wind generators with powers presumably up to 2 MW.

Thus it appears premature to predict today the contribution of wind energy to fulfillment of the electrical-energy needs of 1991. Nevertheless, if one wants to make forecasts on the basis of present knowledge and on the assumption that the important technical and cost-reduction objectives that we face today are all reached, it can be considered that in 1991, several tens of wind engines of 1 to 2 MW each, with total power of several tens of MW and annual production potential of 50-100 million kWh, could be in operation in Italy.

Energy From Urban Wastes and From Agricultural Residues

In recent years, the energy crisis and the problems connected with conservation of resources and the safeguarding of the environment have brought out the necessity of proper management of wastes, which should not be considered solely as a possible polluting burden but also as potentially recoverable and reusable byproducts.

Especially important are the problems connected with disposal of the huge quantity of domestic wastes produced every year; it is sufficient to realize that a recent investigation by the Ecology Committee of the Senate indicates that each member of the national community produces 260 kg of solid urban waste every year.

These wastes have an average moisture content of 20 to 30 percent and an average heat value of about 1,500 kcal per kg. With extrapolation to the entire population, these figures would produce about 14 million tons of wastes per year. On the assumption that 20 percent of this quantity were used and devoted, after appropriate pretreatment, to production of electrical energy, electricity production equal to 1 percent of present needs would be obtained.

It should, however, be pointed out that simple burning, with production of electrical energy, does not in itself represent the preferable solution. There are indeed other alternatives that could prove more suitable, in relation to the various local situations.

In fact, in addition to destruction by incineration (for which the contribution to pollution must be considered) and burning for production of electrical energy, disposal of wastes could involve:

--production of heatonly, for industrial use and for space heating and air-conditioning;

--production of a powdery fuel with heat value on the order of 5,000 kcal per kg;

--utilization in agriculture, after treatment, as suggested not so much by the fertilizing value of wastes as by their state of mechanical aggregation, which favors the formation of humus.

In the case of combustion with production of electrical energy, which is ENEL's interest, a cocombustion technique is being used: the wastes, after suitable pretreatment, are put together with fossil fuel into the boilers of thermoelectric power plants designed for functioning on coal.

The wastes thus constitute an auxiliary fuel in connection with fluid coal and fuel oil. Among those techniques directed toward production of energy, this one is very interesting in its potential state, inasmuch as the investment costs for an incineration plant built ad hoc are avoided, and the wastes are burned in plants that have high efficiencies--up to twice those of an incinerator.

On the other hand, this technique can produce problems and disadvantages in the operation of the boilers.

An essential condition for this process is pretreatment of the wastes in such a way that they take on characteristics that make for complete combustion of them.

The cocombustion technique is in the experimental phase in the United States. The first plant of this kind was the one in St Louis, in operation since 1972. It is a 125-MW coal unit, in which pretreated wastes are burned in a proportion between 10 percent and 27 percent of the total incoming heat.

A second experiment is in progress in Ames, Iowa.

Since 1977, ENEL has been carrying out, in collaboration with the CNR ("Energy Use of Solid Urban Wastes" Subproject of the Purpose-Directed Energy Program) a study and experimentation on the techniques for utilization of solid urban wastes in thermoelectric power-plant boilers.

Within the framework of this research, a series of experimental tests was started in January 1979 in the thermoelectric power plant of Santa Barbara (Arrezzo), operating on lignite, which, because of its existing infrastructures and the fuel used, was considered especially suitable for this type of experimentation.

The first tests done, which were of short duration and involved low flow of wastes, had the main purpose of comparing the operating parameters with normal fuel against the parameters with the lignite-wastes mixture.

Tests of week-long duration and with higher flow of wastes will be carried out shortly, and in the course of them, the concentrations of pollutants and corrosive agents in the combustion gases will be measured also, and chemical analysis of the ashes will be done.

The wastes successfully used for the abovementioned tests come from a treatment plant located in Lombardia and consist only of the organic fraction used for composting. Furthermore, construction of a plant for treatment of the urban wastes of the city of Florence is under study, and this plant should permit a period of 6 to 12 months of experimental combustion operation in the Santa Barbara power plant.

If these experiments are successful, the Santa Barbara power plant could be made capable of disposing of 300,000 tons of wastes per year--that is, the quantity of wastes attributable to a district of about 1 million population. Assuming an average heat value of 1,500 kcal/kg for the urban wastes, it would be possible to achieve a fuel saving equivalent to 45,000 tons of oil-equivalent per year. Naturally, the wastes would have to arrive at the power plant in pretreated form; this implies the building of concentration, transport, pretreatment and storage systems by the municipal districts concerned.

For the purpose of economic evaluation of this solution, it should be taken into account that the disposal by traditional methods of a quantity of wastes equal to that considered would entail an annual expense on the order of 3 billion lire. In parallel with the experiments described, studies are under way to determine the solution that permits combustion of urban wastes in any boiler that is designed for operation with coal. In particular, construction of a suitable treatment plant and development of an autonomous burner for urban wastes only, that will be tested in the Santa Barbara power plant, are under study.

The ENEL tests that have been conducted and are in progress in the Pietrafitta power plant for cocombustion of lignite and pressed-olive residues should also be mentioned with regard to the use of agricultural residues for energy purposes. The tests are yielding satisfactory results, and thus it is considered that pressing residues on the order of 120,000 tons per year can be burned at Pietrafitta, with savings of 50,000 tons of oil-equivalent. This activity will come within the framework of a program for evaluation of the possibilities for use of other agricultural residues for which more suitable uses are not found either in animal husbandry and agriculture or in local utilization for energy purposes.

It would be premature to predict the contribution that agricultural residues can make to production of electrical energy; nevertheless, it is not out of the question that it could prove greater than that obtainable from urban wastes.

Energy From the Sea

The prospect of obtaining energy from the sea may appear fascinating and promising in a country such as ours that has 8,000 km of coastline. Unfortunately, even a fairly superficial analysis of the possible systems for use of the sea as an energy source is sufficient to make it clear that the possibilities for exploitation of it as an integrative source are practically nonexistent.

Without reference to marine biomasses, the marine energy sources that can be utilized for energy purposes are the tides, wave motion, marine currents and the thermal gradient.

(a) Tides

As regards energy from the tides, only two plants have been built in the world so far. The first, and the more important one, is that of Rance in France, which has a power of 240 MW and has been in operation since 1966, and the second one is a small experimental plant at Kislaya Guba in the USSR. The Rance plant, which utilizes a considerable tidal range (8.5 meters), has led to no further development, since it has proved very uneconomical.

For some time, imposing projects have been under study in various countries of Northern Europe (England, France, USSR) (see figure on following page), and in Canada, Argentina and Australia, to exploit the tides at sites where the the morphology of the coasts raises the phenomenon to ranges between 8 and 15 meters.

However, none of these projects has so far been put into effect, both because of the very high costs and, in some cases, because of the possible effects on the environment. If it is kept in mind that the biggest range of all Italian tides, occurring in the upper Adriatic, does not even reach 1 meter, and that the energy producible from a tidal power plant is proportional to the square of the tidal range, it is a simple conclusion that there is no prospect of development of tidal power plants in Italy.

(b) Wave Motion

The use of wave motion for energy purposes has been a subject of study for some time. The attention devoted to this utilization increased considerably after 1973 in those countries, such as the United Kingdom and Japan, whose coasts have waves that are sufficiently regular and of considerable height. Experimental and pilot apparatuses are under study or being built in these countries.

Sites potentially favorable for installation of tidal power plants (from EUROCEAN [expansion unknown], Monaco 1978)

Key :

1. Tidal power plants 2. Built 3. Under study

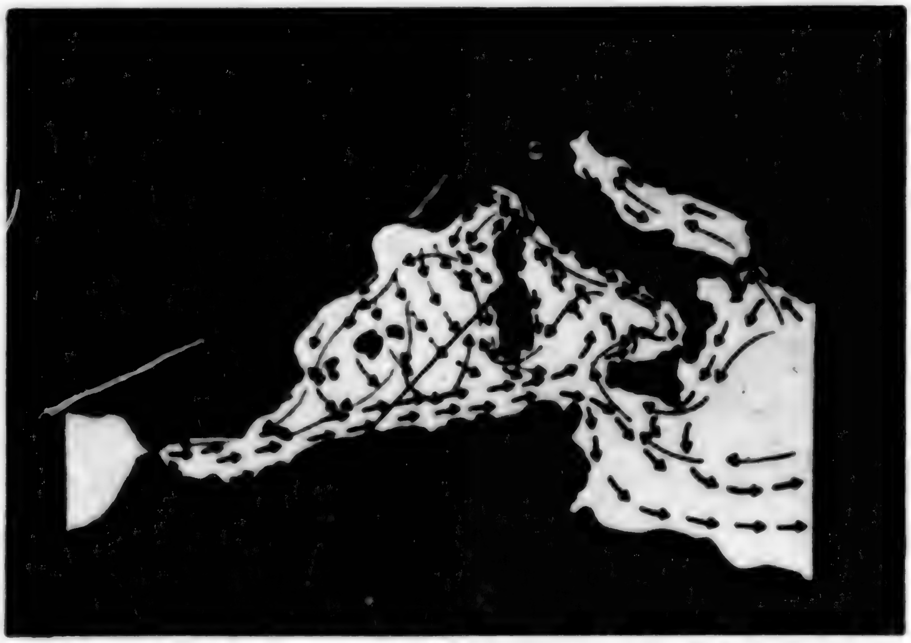
The potential of the waves, expressed in kW per meter of wave front, is heavily dependent on wave height: it is 4 kW per meter for waves 1 m high, and rises to 20 and 50 kW per meter, respectively, for waves of 2 m and 3m. To evaluate the feasibility of a porposed plant, it is necessary first to determine the characteristics of the wave motion; the network of wave meters whcih ENEL has for some time had in place for gathering information intended mainly for the designing of thermal power plants and for safeguarding the coastal zones concerned furnishes interesting data in this regard. The table below gives the wave heights and frequencies recorded in three Italian coastal localities in 1977. It shows that waves with height of more than 2.5 m occur only 6 percent to 16 percent of the time. If it is kept in mind that the average height of the waves of the Atlantic sites under study in the United Kingdom is generally between 2.5 and 3 m, and that for such sites the advisability and suitability of utilizing wave motion still remains to be demonstrated, it is easily concluded that such utilization has no prospect for industrial application in Italy because of the low quantities of energy that could be produced per meter of wave front.

Wave Height and Frequency Recorded in 1977
by Several ENEL Wave Meters

	Localities		
Wave Height	Lerici	Montalto	Porto Tolle
0 cm	0%	8%	11%
10 cm	6%	20%	19%
50 cm	54%	46%	54%
125 cm	24%	16%	10%
250 cm	11%	9%	5%
400 cm	4%	1%	1%
600 cm	1%	--	--

(c) Marine Currents

Utilization of the kinetic energy of the permanent and seasonal marine currents is under study, particularly in the United States and in Canada.



Course of the currents in the western Mediterranean
and higher average values along the Italian coasts

Key:

1. Corsica Channel
2. Otranto Channel
3. Bonifacio Straits
4. Currents
5. Surface
6. Deep

Apart from finding sites that are morphologically suitable and characterized by currents of at least 1 to 1.5 m per second, the big problems are the development of turbines of completely new design and the ecological effects which alteration of the currents could have on the marine environment.

The currents along the Italian coasts are rather limited (see figure on preceding page); indeed, the averages for some especially favorable sites are:

--Corsica Channel	0.5 m per second
--Piombino Channel	0.2 m per second
--Otranto Channel	0.3 m per second

The potentially most interesting site is the Straits of Messina.

Utilization of the Straits is under study by ENEL today, and the energy theoretically obtainable is about 2.9 billion kWh per year. The first question that arises concerns the proportion of this energy that could be used without adversely affecting maintenance of the natural phenomena, the conservation of the environment, and navigation. The hypothesis of utilization of 20 percent would mean an annual production potential of 600 GWh, with very high production costs and with environmental consequences that are not easy to evaluate. Production on this scale certainly appears rather modest in view of the complex of environmental problems and the construction problems related to the considerable difficulty of designing and building submerged hydraulic structures on a site that is delicate from the hydraulic, geological and seismic points of view.

Furthermore, there are no turbines today that are capable of utilizing the kinetic energy of huge volumes of water at relatively low velocities--unless a real leap forward should occur--and capable of functioning at variable speeds, and reversible to boot.

The economic picture could become less discouraging if the choice for the link between the mainland and Sicily fell to the plan that provides for a submerged structure for the road and rail links.

(d) Thermal Gradient

As is known, the thermal gradient of the seas can be used to produce electrical energy: in a heat exchanger, the warm water of the surface layers of the sea makes a fluid with low boiling point evaporate; this evaporation drives a turbine, and the fluid is condensed in a condenser run on the cold water of the deeper layers.

A system of this type requires a thermal jump of at least 20° C to be able to achieve a suitable thermodynamic cycle.

Experimental plants based on this principle are under study in the United States. As regards the Mediterranean, because of the limited depth of the Straits of Gibraltar, which does not permit the circulation of deep waters of polar origin, the thermal gradients rarely exceed 10° C, and this fact rules out any practical possibility of achieving an acceptable thermodynamic cycle.

USE OF PEAT FOR POWER GENERATION IN SWEDEN

20-Year Prospects

Stockholm SVENSKA DAGBLADET in Swedish 9 Jan 80 p 7

[Article by Erik Liden]

[Text] "Within a 20-year period 5 to 10 percent of current oil consumption in Sweden could be replaced by peat. In a few years time the rising price of oil has given peat a competitive edge."

So says civil engineer Conny Ryytty who is studying solid fuel at the Swedish Development Company, SU, owned by State Enterprises.

"Even though the peat is located at a distance and there is not as much of it as there is in Finland it is competitive with oil today. If one takes the figures of the Energy Commission, counting on a low 'inflation adjusted' interest of around 4 percent, peat is now 20 percent cheaper than oil overall. In spite of the costly investment, 50 percent more than in the case of oil, and higher operating and maintenance costs peat is of interest even now as a fuel for central hot-water systems for remote heating and industrial furnaces."

Half as Expensive

At today's prices peat is estimated to cost 460 kronor per ton of oil. On 19 December 1979 oil cost 870 kronor per cubic meter for heating oil No 4 with a normal sulfur content, in other words heavy heating oil, not home heating oil. This means that peat could be purchased for roughly half the cost of oil.

Conny Ryytty gave a cost estimate for a hot-water central heating system of 60 megawatts. With one boiler for peat and two for oil he arrived at an annual cost of 15 million kronor, no more expensive than a separate oil installation. In the long run peat systems will be cheaper even if one estimates 20 percent interest on investments.

In industrial furnaces 90 percent of the energy comes from peat, the rest is support heating with oil. The peat is trucked in from a bog no more than 50 km away from the furnace. Already today with the higher interest rate peat is cheaper than oil, peat being a little under and oil a little over 12 million kronor in total annutal costs.

Conny Ryytty: "With the lower interest rate used by the Energy Commission peat is clearly cheaper, with the higher rate oil and peat are about equal. But oil prices and the reliability of peat deliveries are good reasons for peat to become increasingly competitive.

"In southern Sweden with maximum production one can provide enough peat per year to equal 3.5 to 4 million tons of oil. We now estimate that only about half this amount can be extracted, partly for environmental reasons. In some bogs the peat can be transformed on the spot into other fuels, such as methanol. It simply wouldn't pay to transport it."

Ryytty's figures are included in a report that will be given to the Board for Energy Production Research in February. The report will be called, "The Future Fuel Market."

These are the cost distribution percentages for central hot-water systems and industrial furnaces with low interest rates:

	Oil alone	Peat
Capital costs	8	16
Operation and maintenance	10	25
Fuel	82	56
Transport (truck)	--	3
Total	100 %	100 %

First Major Power Plant

Stockholm SVENSKA DAGBLADET in Swedish 9 Jan 80 p 7

[Article by Erik Liden]

[Text] In February 1980 Sweden's first big industrial plant for heating with solid fuel, mainly peat, will start operating. The Assi-Lovholmen factory in Pitea will be opening a plant costing 68 million kronor.

Director Sigurd Wendleman said, "We are very satisfied with our energy situation at the factory. Even before we start using peat our oil consumption has been reduced from 75,000 cubic meters in 1974 to 47,000 cubic meters in 1979. The higher prices forced us to use the oil more efficiently.

"The peat furnace can also be fueled with bark and wood chips. After an initial phase we hope to be able to stop firing with oil even though in an emergency oil could still be used. The peat is pulverized and dried with the help of smoke gases that are otherwise discharged into the air."

Imported

The furnace will use 400,000 cubic meters of cut peat a year in full operation. The peat is imported from northern Finland and 10 to 12 truckloads a day will be delivered, a total of 1000 cubic meters of peat. Despite the distance and the need to import it the peat from Finland is cheaper than a corresponding quantity of oil.

In the long run Assi is counting on peat being cut from bogs in Norrbotten. A search 9 miles from Pitea turned up large deposits. The state has invested 34 million kronor in the Pitea project which will be of great importance in making decisions on big Swedish investments in heating with peat in the future.

"We have linked Pitea's remote heating network with our plant. By using our secondary heat the town saves 8000 cubic meters of oil a year, representing 10 million kronor at current prices. Today 3000 households benefit from this arrangement and the number will probably rise to 4500 by 1985," said Sigurd Wendleman.

Advantages and Disadvantages of Peat

These are the advantages of using peat as a fuel:

There are large quantities of peat in both northern and southern Sweden.

It will be cheaper to use than oil.

The firing technology already exists.

Burning peat poses few environmental risks.

These are the disadvantages of peat:

Peat mining requires big clean-up expenses for environmental reasons.

Investments are more expensive than they are for oil.

Peat requires a lot of room and is hard to dry.

Peat can only be cut during the summertime.

Transportation costs rise when longer distances are involved.

6578
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'EARTH HEATING' SYSTEM SAVES DOMESTIC ENERGY

Stockholm SVENSKA DAGBLADET in Swedish 7 Jan 80 p 5

[Article by Margareta Artsman]

[Text] Goteborg--In the future heat from the earth will reduce our oil dependency considerably. Taking heat from the ground with the help of a heat pump can give an energy savings of 60 percent according to Professor Bjorn Karlsson who is associated with Chalmers in Goteborg. We can get three parts of heat from using one part of electrical energy.

Three projects are currently being followed with special interest by the so-called "earth heating group" at Chalmers. They include 88 houses being built on the site of the Surte landslip, 24 houses in Orsa, Dalarna and one home in Utby outside Goteborg.

The Utby house is a pilot project under the direction of Professor Gosta Rosenblad. We should keep an eye on it in the future. The house will be heated with a so-called vertical earth heating system.

Instead of laying the network of pipes horizontally in the ground--as will be done at Surte and Orsa--the pipes will be placed vertically in the ground to a depth of 10 meters where the temperature is a constant +8° C. all year round. The pipes will be filled with water and glycol which will circulate and absorb the heat from the ground.

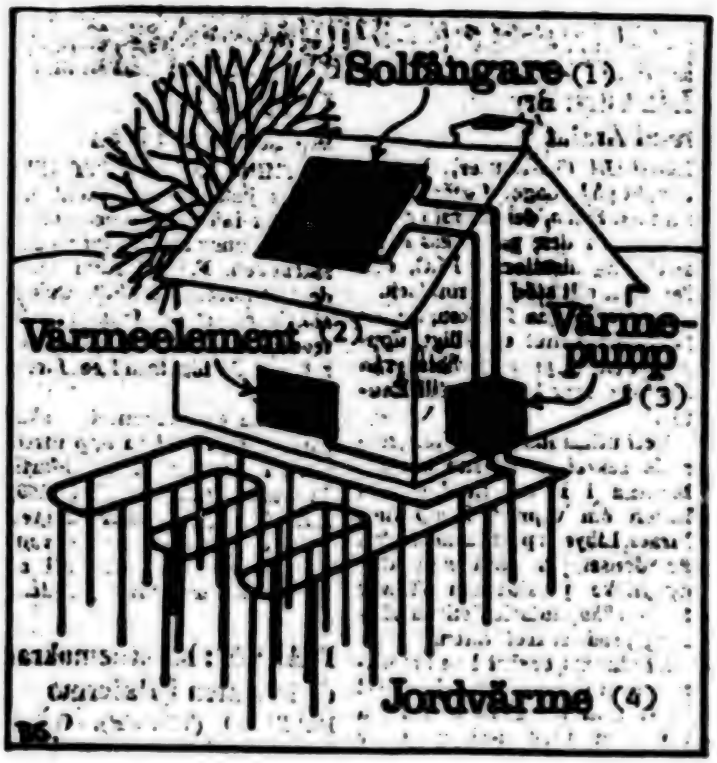
Opposite of Refrigerator

The heat is conveyed to an earth heat pump which acts like a refrigerator in reverse. The cooling elements in the refrigerator have the same function as the pipes in the ground.

Just before Christmas the first families moved into the Surte project houses. The Chalmers research group will be studying the houses there over the next few years, checking energy usage, costs, etc. as well as evaluating the construction of the earth heat pump.

The drawback with the Surte system is that the horizontal pipes take up such large ground areas. Each house requires 300-350 meters of pipe buried at a depth of 80-90 cm. This means that between 400 and 600 square meters of ground surface is needed for each house.

The Utby house with its vertical pipes does not need a surface any larger than that of the house to be heated. The cost is expected to be about the same as at Surte where the extra cost is estimated at 20-25,000 kronor. But the earth heat pump will have paid for itself in 5 years, Bjorn Karlsson said.



This is how the vertical earth heating system being tested by Chalmers in a pilot experiment in Utby, just outside the center of Goteborg, works. The heating pipes go down 10 meters into the ground. To restore the heat to the ground in the summertime a solar collector or an air battery can be installed. This will be added to the Utby house later.

Key:

1. Solar collector
2. Heating element
3. Heat pump
4. Earth heat

Heated Pilings

In Utby the ground must be "recharged" with energy in the summer since heat does not restore itself in the vertical system. This can be done in several ways, using a solar collector or an air battery (heat exchange) that carries the warm outdoor air into the ground. Heat can also be pumped down from the house. A simple method for which a patent has been applied is to blow heat down through hollow piles, since pilings must always be used in the Goteborg clay subsoil. And clay or loose sand are the best types of soil for the system.

In the Utby house an air battery with fans will be used to replace heat in the summertime.

The earth heating group does not think much of solar collectors.

"These are expensive installations that are unlikely to come down in price," said Professor Thore Berntsson of the Heating Technology and Engineering Institution. "I regard solar collectors as unrealistic for single-family homes. They are possibilities for big new building complexes but the initial enthusiasm has given way to more realistic thinking."

In a few years the earth heating group hopes to test the vertical system in a large housing area, such as a group of four or five apartment houses with a small central hot-water system.

Cheapest

"We have compared the costs of four potential heating systems for a single apartment house with 30 units," said Thore Berntsson. The choices were an oil furnace, electric heat, a diesel-powered heat pump using the outside air as a source of heat and an electric-powered heat pump with vertical earth heating pipes. The heat pump was definitely the cheapest. We took interest and energy price increases into consideration.

"But the system is no good for an urban center with remote heating systems," Thore Berntsson said.

He believes that by the mid-1980's vertical earth heating will be commercially utilized to the fullest.

Bjorn Karlsson added that in the future we will probably have much bigger heat pumps serving larger residential areas.

"It costs money to learn more about the technology but otherwise earth heating is quite realistic and economical," said civil engineer Bernt Backstrom of the Chalmers earth heating group.

A distinction is made between surface earth heat and deep ground heat. The interest of the Chalmers group is now directed toward deep ground heat, i.e. the possibility of storing heat at greater depths, from a few meters below the surface down to 15-20 meters. As yet there are no deep ground systems in practical operation. The Utby project and a new school in Kungsbacka--Lindalvs School--will give some indications. At Lindalvs School they plan to operate the heat pump with diesel power.

Today over 2000 houses in Sweden are heated with surface earth heat. The main system in use is the Aga-Thermia system.

With regard to surface heat the scientists don't really know yet how it will affect plants and small animals in the ground. There is no real biological life in the dense clay layers further down but geological and geohydrological effects should be studied there.

The future of the earth heating system depends on how much clay soil there is in this country, according to Bernt Backstrom. Chalmers geologists are working with a survey map of Sweden to locate the best areas. And apparently there is a good supply of clay.

Other important questions are installation costs, restoration of the soil, etc.

"Obviously a great deal of oil is saved when you use earth heat. But bear in mind that a third of the oil energy saved must be supplied in the form of electrical energy. There are no diesel-powered pumps in Sweden yet. But they will come. Research installations will be built in Sweden.

"If we operate the pumps with electricity, nuclear power will come into the picture," Bernt Backstrom said. "If we keep nuclear power earth heating pumps and other heat pumps can be a way to utilize electrical energy economically for heating purposes."

Advantages and Disadvantages

Advantages: The system saves on oil. But for the time being the pump is operated with electrical energy.

Disadvantages: Surface earth heat requires large land areas, which is not the case with deep ground heat. And nothing is known about how the pipe system just under the surface affects biological life there. Studies are also being made of what happens in the ground at greater depths.

Costs: No evaluation has yet been made of the costs compared with those of other heating systems.

Limitations: One must know where clay soils are located and how suitable they are for building. But there is a lot of clay soil in this country.

6578
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INERTIAL ENERGY STORAGE DEVICE FOR VEHICLES

Stockholm DAGENS NYHETER in Swedish 29 Dec 79 p 3

[Article by Roland Gyllander]

[Text] Each time a car or bus puts on the brakes at a red light its kinetic energy is changed into unutilized heat in the brake drums.

Each time it starts up again the engine has to build up more kinetic energy from expensive gasoline.

At the next red light or stop sign this energy shift is repeated. But there are ways to store kinetic energy.

This is easiest to accomplish with an electrically powered trolley system. A tested method has already been used in the old trolley cars, the drafty crates where the driver stood up front and turned a brass handle.

If he turned it to one side the current was released from the cable to the motor and the trolley car accelerated. If he turned it to the other side the whole thing switched over so that the engine began to work as an electric generator, powered by the revolving trolley wheels. The current from the generator was spent in great electrical resistance which provided heat with which to warm up the trolley.

It was hard for the trolley car to operate its engine as a generator and that was the point: the trolley car braked to a halt.

The modern semiconductor technique (transistors, tyristors, etc.) has made it possible to return the generator current from the braking motor to the cable so that other trolley cars on the same line can use it. In that way a braking trolley can get another trolley car going somewhere else.

ASEA [Swedish General Electric Corporation] is already testing this kind of trolley in Melbourne and Goteborg is considering a similar trial. Trolley cars and trolley buses in city traffic can obtain maximum benefits from the system since they start and stop at such close intervals.

But subways can also use this method. SL [expansion unknown] has had 14 double cars equipped with this sytem going on the Jarva line for several years and according to chief engineer Ola Kallberg of the SL car section there has been a 20 percent recovery of the energy consumed.

"We are now modernizing the cars on the Farsta line, 330 of them, and we could install the new tyristor system in them. But it would cost 110 million kronor more," he said.

According to Lars Olof Nilsson, sales chief of ASEA's vehicle division, it is realistic to count on saving a third of the energy on electrically powered rail traffic in relatively dense stop and go traffic, in other words urban mass transit.

With regard to vehicles in individual transit--cars, buses--the problem of energy recovery must be solved for each individual vehicle. Even though it is a fascinating thought of course that braking cars could help ease the energy crisis by giving a boost to cars starting up....

The simplest and perhaps the most promising method is to store kinetic energy in a flywheel. The rear axle of the car can be connected to a flywheel in such a way that it is forced to accelerate its rotation when the car stops. The flywheel "steals" the rotation of the car wheels. When the car stands still the flywheel rotates at its fastest speed and when one starts up again the flywheel is connected to the rear axle again and helps the car engine "get the car going."

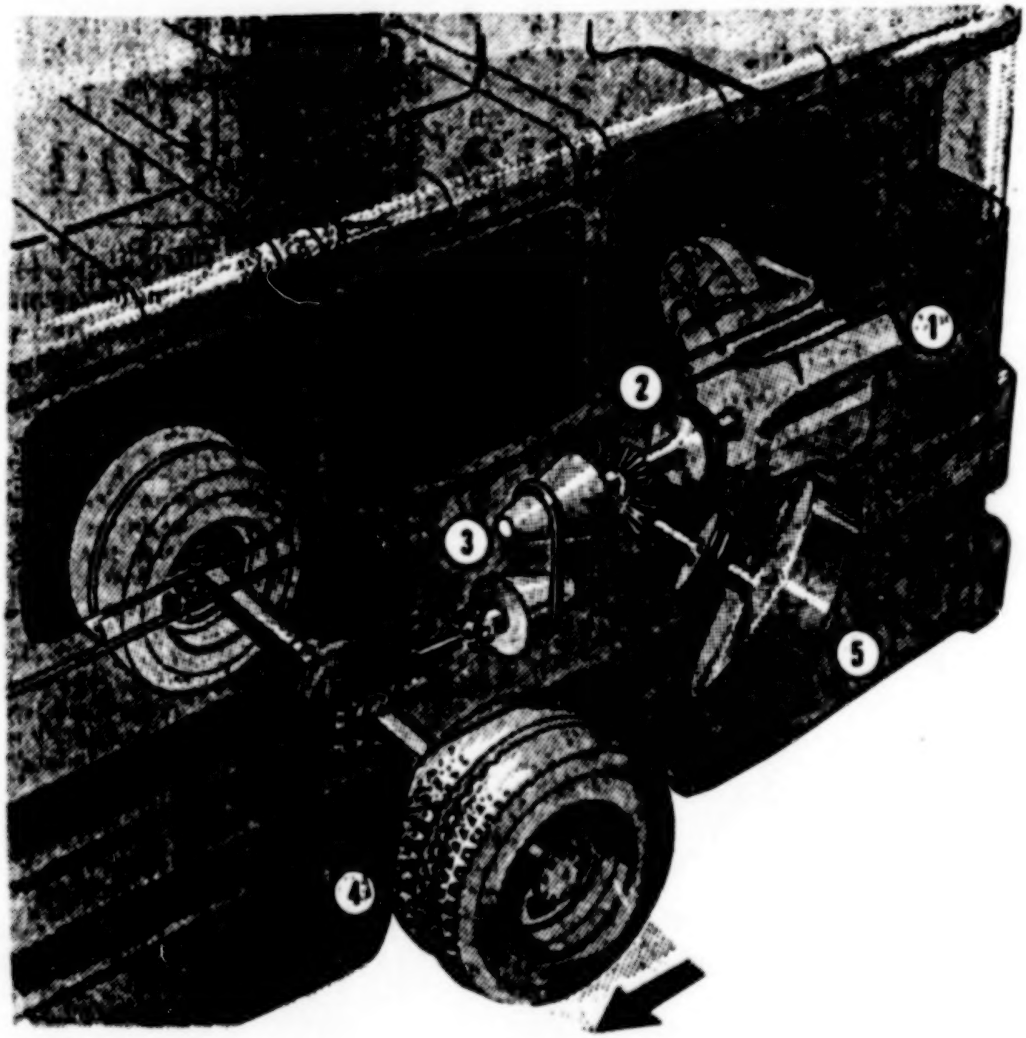
Already German buses of the MAN type are being test driven with such a system of what is called regenerative braking. The energy is stored in a flywheel or in a pressure tank (hydraulic pumps collect the energy of the bus when it stops and transform it into pressure energy in big tanks. When the bus starts up again the pumps act as a motor, driven by the pressure in the tanks).

It is estimated that the buses can save as much as 20 percent on fuel when the system has been ironed out. Other benefits are improved acceleration, reduced fuel storage and cleaner exhausts since the motor is operated more evenly.

One of the problems is to find construction materials that will last. In the MAN buses a steel disk weighing 105 kilograms rotates at up to 8000 revolutions a minute, requiring a heavy sheath weighing several hundred kilograms around it as a safeguard if it is pulled apart by centrifugal force.

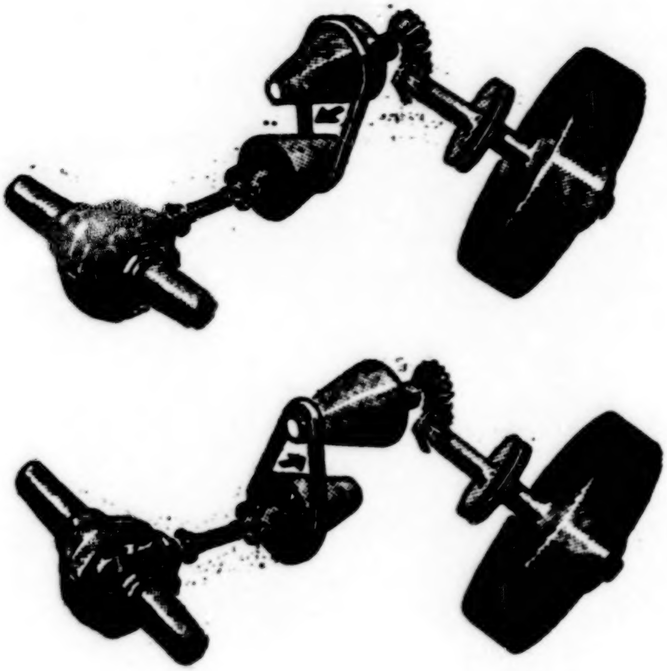
"In the United States they are trying to develop lighter flywheels made of so-called composite materials that can withstand greater speeds," said technical director Lars Ojefors of the Swedish Development Company. "This is a kind of fiber construction that does not burst but is turned into something like cotton waste in case of an accident. The kinetic energy is turned into heat."

This kind of flywheel doesn't need to weigh more than 2 or 3 kilograms and the entire energy storage system would not weigh more than 15. This kind of energy storage could be used by ordinary passenger cars.



In simplified form this shows how the "energy brake" functions on a bus. The engine (1) in the back turns the rear wheel (4) via a coupling (2) and a stepless transmission (3). In braking a large flywheel (5) is engaged, being connected to the rear wheel above the transmission...

so that the flywheel is forced to rotate.



In starting up again the flywheel is reconnected to the rear wheel and gets the bus going.

The flywheel weighs more than 100 kg and is housed with its planetary gear in a protective sheath that cannot burst. It is located in the rear of the bus.

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